

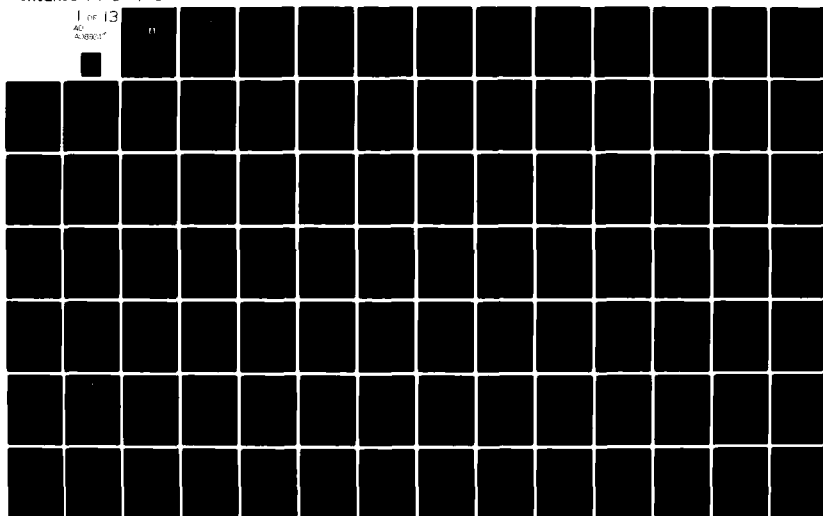
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EXPERIENCE OF SOVIET MEDICINE IN A GREAT PATRIOTIC WAR 1941-194--ETC(U)  
AUG 80 D G GOL'DBERG, I Y RAZDOL'SKIY  
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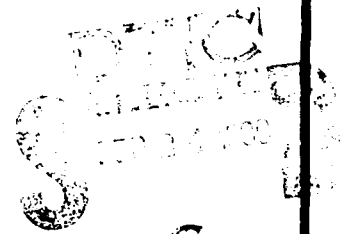
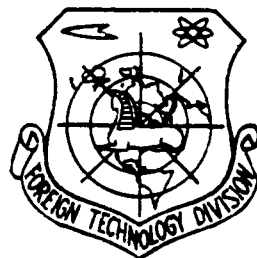
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FOREIGN TECHNOLOGY DIVISION



EXPERIENCE OF SOVIET MEDICINE IN A GREAT  
PATRIOTIC WAR 1941-1945



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## UNEDITED MACHINE TRANSLATION

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EXPERIENCE OF SOVIET MEDICINE IN A GREAT  
PATRIOTIC WAR 1941-1945

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PREPARED BY:

TRANSLATION DIVISION  
FOREIGN TECHNOLOGY DIVISION  
WP-afb, OHIO.

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# U. S. BOARD ON GEOGRAPHIC NAMES transliteration SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	<i>А а</i>	A, a	Р р	<i>Р р</i>	R, r
Б б	<i>Б б</i>	B, b	С с	<i>С с</i>	S, s
В в	<i>В в</i>	V, v	Т т	<i>Т т</i>	T, t
Г г	<i>Г г</i>	G, g	У у	<i>У у</i>	U, u
Д д	<i>Д д</i>	D, d	Ф ф	<i>Ф ф</i>	F, f
Е е	<i>Е е</i>	Ye, ye; E, e*	Х х	<i>Х х</i>	Kh, kh
Ж ж	<i>Ж ж</i>	Zh, zh	Ц ц	<i>Ц ц</i>	Ts, ts
З з	<i>З з</i>	Z, z	Ч ч	<i>Ч ч</i>	Ch, ch
И и	<i>И и</i>	I, i	Ш ш	<i>Ш ш</i>	Sh, sh
Й й	<i>Й й</i>	Y, y	Щ щ	<i>Щ щ</i>	Shch, sch
К к	<i>К к</i>	K, k	Ъ ъ	<i>Ъ ъ</i>	"
Л л	<i>Л л</i>	L, l	Ы ы	<i>Ы ы</i>	Y, y
М м	<i>М м</i>	M, m	Ь ь	<i>Ь ь</i>	'
Н н	<i>Н н</i>	N, n	Э э	<i>Э э</i>	E, e
О о	<i>О о</i>	O, o	Ю ю	<i>Ю ю</i>	Yu, yu
П п	<i>П п</i>	P, p	Я я	<i>Я я</i>	Ya, ya

\*ye initially, after vowels, and after ъ, ь; e elsewhere.  
When written as ё in Russian, transliterate as yë or ë.

## RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	sinh <sup>-1</sup>
cos	cos	ch	cosh	arc ch	cosh <sup>-1</sup>
tg	tan	th	tanh	arc th	tanh <sup>-1</sup>
ctg	cot	cth	coth	arc cth	coth <sup>-1</sup>
sec	sec	sch	sech	arc sch	sech <sup>-1</sup>
cosec	csc	csch	csch	arc csch	csch <sup>-1</sup>

## Russian English

rot curl  
lg log

DOC = 80079101

PAGE 1

Page 1.

Experience of Soviet medicine in a Great Patriotic War 1941-1945.

Pages 2-5 no typing.

Page 6.

Part I.

SURGERY.

Page 7.

Section ~~of the~~ seven ~~was~~.

Bullet wounds and damages of spine and spinal cord.

Pages 8-14 no typing.

[Translator's Note: Edge/fin should read rib]

Page 15.

General ~~General~~ unit.

Chapter I.

Short historical survey/coverage of the surgical treatment of bullet wounds and damages of spine and spinal cord.

Candidate of medical sciences docent D. G. Gol'dberg.

The survey/coverage of the development of surgical treatment of the bullet wounds of spine and spinal cord, based on precise anatomical data, one should begin from N. I. Pirogov.

Already in its first work on the military field surgery "Report about the surgical textbooks, shown/rendered by wounded during siege and exercise of the reinforcement of Salta" (1847) is given the description of removal/distance in the wounded of the bullet, which lay/rested on the cross extensions of neck vertebrae. In other wounded, operated by the assistant of N. I. Pirogov, the bullet entered above right spatula and was stopped about the spinal column. Wound was expanded under ether anesthesia. "After operation/process in wounded was established/installed the numbness of extremities".

Subsequently the wounded "is evacuated into Kumyn with hope". This shows that N. I. Pirogov the first of the Soviet surgeons tried to operate those wounded the spine and the spinal cord under the field conditions.

The more systematic bases of the organization of surgical aid by wounded generally and wounded the spine were in particular developed by N. I. Pirogov in the Crimean War 1853-1856 and it is in detail presented by it in the "Beginnings of general/common/total military field surgery". In the cited work the author gives statistics of the wounds of spine, calculating their frequency into 3.0-4.0o/o. In detail describing the severity of clinical picture with the wounds of spine, N. I. Pirogov indicates that "even in the special separation/section of hospital for this genus of patients it is necessary to have an even more special quarters/premises". Reasonably estimating the danger in operation/process as a result of the series/number of complications, N. I. Pirogov only sometimes, with deep wounds of spine, sectioned/cut in the different directions, driving out free fragments. However, "in the fresh cases when and the place of break, and the transfer of scrap cannot be recognized almost, and paralysis is developed rapidly, I do not see rescue in the primary resection or the trepanation".

Reflecting the foremost views of the surgeons of that time, N.

I. Pirogov at his "Beginnings of general/common/total military field surgery" wrote further: "If trepanation and resection of the bones of skull give inaccurate results, then it goes without saying these operations/processes are even less reliable on the vertebrae.

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Three or four happy case (Smith, Edwards, Bler) of 24 trepanations, produced not in the bullet damages (discharge of N. I. Pirogov) of vertebrae, hardly can impel medical officers to the new attempts".

If N. I. Pirogov was inclined to allow operations/processes on the spine, then only with the wounds, which were being escorted/tracked by the incomplete violation of the conductivity of spinal cord ("when both extremities not to the identical degree they were paresized and not completely"), and besides in the late period ("when the crushed bone it grew together itself and paralysis no longer was progressive").

Besides N. I. Pirogov, in the Crimean War operated on the spine and A. Sokolov. In the annual report about military-temporary/time hospital No 1 he mentions about 14 cases of the wounds of the spine: of them in 5 cases was produced the operation/process, in 2 cases which ended by death.



The conservative point of view adhered to the foreign surgeons of that time. Thus, during the Franco-Prussian war 1870-1871 the treatment of the bullet wounds of spine and spinal cord consisted in the granting to the wounded of "possible rest, the wiping of skin by lead water and the compresses". To this it was added the catheterization of the bladder and daily enemas [Lemberg (Lemberg)]. If in wounded were detected the signs of the compression of spinal cord, surgeons tried in the early period of wound to drive out foreign bodies and bone fragments from the available divisions of wound canal. In all remaining cases the doctors usually abstained from any surgical intervention, since this could lead "to the considerable hemorrhage and the autopsy of spinal canal with the danger of inflammation and subsequent softening of spinal cord" [Beck (Beck)]. And this palliative surgical intervention within the time of war 1870-1871 of 167 that wounded in the spine underwent only 10 people.

This tactics of the surgeons of the second half the XIX century is completely clear. The absence of asepsis and antiseptic did not create conditions for the development of the surgery of spine generally and bullet wounds of it in particular. Due to the impossibility to struggle with different infectious complications,

which were being developed in wounded before and after operation/process, was unavoidable large mortality.

The rapid development of medicine in the second half the XIX century, connected with the discoveries/openings of Pasteur (Pasteur), of I. I. Mechnikov et al., introduction to the practical custom of antiseptics (1867) and asepsis (1892) served as an impetus to the progressive development of surgery. But these discoveries/openings of the XIX century did not contribute to the proper development of the surgery of spine with the bullet wounds despite the fact that since 1884 was already developed in the basic details of laminectomy technique.

In the Russo-Turkish war 1877-1878 (K. K. Reyer et al.), Greco-Turkish war 1897 (I. E. Gagen-Thorn), the Spanish-American war 1898, the Anglo-Boer war 1899-1902 [Kuttner (Kuttner)] and the so-called "Chinese expedition" (1900-1901), it is more accurate, the imperialistic suppression of the Chinese liberation movement of known into the history by the name "Boxer rebellion", the majority of surgeons in essence adhered to the conservative tactics (M. A. Galinas).

As noted K. K. Reyer et al., operational activity during the Russo-Turkish war with the bullet wounds of spine and spinal cord was

restricted.

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Thus, is information on the Caucasian army about 7 those wounded the spine, that were subjected "conservative-operational treatment", by the Danube army - about 15 "consecutive" operations/processes with the bullet wounds of the spine (recovered 3) and about one case of "primary operation/process" with the incomplete recovery.

In 1894 F. I. Berezkin described the case of surgical treatment with the bullet wound of spine at the level of the XI thoracic vertebra. Wounded was operated twice, since during first laminectomy bullet could not be found, and only through 2 weeks with the repeated operation/process was removed bullet and bone fragment. After operation/process advanced the improvement.

The increasing interest of the Soviet surgeons of that time in the operations/processes on the spine is convincingly confirmed by separate works on the history of the surgery of spine (V. Vladykin, 1896).

In the following, 1897, to year V. M. Bekhterev expressed thought about the need for production in the operations/processes on

the central nervous system by neuropathologist himself, about the large unit/formation of together surgical and neurologic knowledge, i.e., about the liberation/excretion of new specialty - neurosurgery.

In spite of the failures of the first operations/processes, interest in the surgery of spine did not weaken, and a question about breaks and damages of spine was set for discussion of the I congress/descent of russian surgeons in 1900.

In 1902 V. A. Svetsitskiy published short leadership/manual on the military field surgery where in chapter about the wounds of spine, together with the series/number of general considerations, he expressed thought, that those wounded the spine and the spinal cord more frequently perish from the inaction than from the operations/processes. But this position/situation about the dependence of issue on surgeon's activity yet did not obtain general/common/total acknowledgement.

On V. A. Svetsitskiy's report in the Moscow society of the Russian surgeons 19/IX 1903 L. S. Minor in the debate stated that he "observed to 60 cerebrospinal wounds and for the recovery by their surgeons until this time she was undertaken very little or directly nothing".

This blame to surgeons was completely distinguished, although it found the known explanation in the fact that one technical side of operation/process did not solve completely the problem of the treatment of the wounds of spine. It was necessary to the operation/process to accurately establish/install localization of foreign body and to determine the character/nature of the damage of spine and spinal cord.

The discovery/opening X-rays into 1895, which lightened the work of the surgeons in many regions, initially (taking into account the technical level of the X-ray analysis of that time) still relatively little helped with the wounds of spine. Was required much time for the detailed development of this question. By this is explained the fact that, according to M. P. Postolov's data, to 1903 are published only 47 cases of the surgical treatment of the bullet wounds of spine and spinal cord with 33 fatal results. This high mortality rate could not but influence the surgical tactics during the treatment of the bullet wounds of spine.

In the Russo-Japanese war 1904-1905 which occurred at a distance of 10000 km from central Russia, surgical aid by that wounded the spine was transferred into the deep rear. In the reports about this war there are only separate indications of produced laminectomy (V. B. Gyubbenet, R. R. Vreden, P. F. Kolchin et al.).

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However, main trend was conservative, although were by this time already published several works about the advisability of operation/process with such wounds (P. I. Berezkin, L. M. Pussep, V. A. Svantsitskiy et al.).

The evacuation of wounded generally, and together with this and wounded the spine was reduced at that time to the most rapid possible "scattering" of patients by the method of their transport from the stage to the stage into the deep rear. This tactics "evacuation into that that not it stopped" it led to the fact that an operational-surgical aid by that wounded the spine in the foremost therapeutic institutions barely proved to be, but it was transferred into the institutions of the deep rear which the wounded with the damage of spinal cord rarely achieved.

R. R. Vreden as the chief surgeon of Manchurian army recommended to detain such wounded in the foremost infirmaries for a long time, holding their first week on the stretching, and with the failure of conservative treatment the only producing of laminectomy. According to his data, published in the "Practical leadership/manual on the

military field surgery" (1911), of 12 that operated in the field mobile hospital died 8. After operation/process R. R. Vreden held the wounded of 3-4 weeks on the stretching, after which he evacuated in the gypsum bedspread.

Without depending on the character/nature of the applied treatment R. R. Vreden recommended the detaining of wounded with the damage of spinal cord in the spare hospital (army area) not less than 6 weeks.

From that outlined above it is evident that during the Russo-Japanese war the majority of the surgeons of Russian army adhered to the conservative therapy of the bullet wounds of spine and spinal cord. The same tactics according to the communications/reports of V. B. Gyubbenet adhered to Japanese surgeons.

In the subsequent decade was published the series/number of the works, which testified about the effectiveness of surgical intervention with the bullet wounds and the closed damages of spine (P. I. D'yakonov, A. A. Opokin, V. P. Kozlovskiy, A. I. Okinshevich, Z. I. Ponomarev, L. M. Pussep, V. M. Zerenin, N. N. Burdenko, V. A. Oppel', I. I. Grekov and many others). However, it should be noted that these authors' personal experience was based on the single observations and their communications/reports more frequently carried

casuistic character/nature.

At the IX congress/descent of russian surgeons in 1900 A. V. Opokin reported 25 laminectomies, assembled by it based on materials of the Russian surgeons, moreover 14 laminectomies were produced with the bullet wounds. Both author himself and those appeared in the debate (P. I. Berezkin et al.) enthusiastically support laminectomy.

In the period of Balkan wars 1912-1913, according to the data of A. V. Britnev et al., the aid by that wounded the spine and the spinal cord was set badly/poorly. On the reports of 28 orders of the Russian red cross, participating in the armies belligerent countries, were produced only 5 operations/processes on the spine.

In the Balkan war the percentage of lethality with the bullet wounds of spine and spinal cord, according to A. V. Britnev, achieved 95.0 and even 100.0. The same position/situation was noted also in the foreign armies. In the year to the first world war (in 1913) appeared the original works of V. L. Pokotilo and L. M. Pussep about the damages of spine. Both authors proposed early surgical interventions.

In the opinion of V. L. Pokotilo, "it is better to be convinced of the fact that the operation/process is not necessary, than to leave



spinal cord in the position/situation, which dooms it to the death".

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The first world war 1914-1918 with its unprecedented until that time quantity of wounded again placed before the surgeons the problem of the treatment of the bullet wounds of spine and spinal cord. The experiment/experience of the past wars XIX and the beginning XX, the century, in the opinion of many surgeons, testified about the hopelessness of the surgical treatment of those wounded the spine and the spinal cord. Nevertheless with each year of war a number of supporters of the surgical treatment of the bullet wounds of spine noticeably grew/rose.

Thus, already during January 1915 P. K. Zavadsky reported at the conference of the doctors of North Western Front about 20 laminectomies. Lecturer arrived at the conclusion that "if the patient is not operated, above it is pronounced fateful sentence". At the same time the active tactics of the surgeons supported V. G. Tsege-Manteyfe et al. The expectant conservative therapy supported N. B. Krol' et al.

Later for the active therapy were voiced in the press/printing N. I. Napalkov, L. M. Pussep, V. M. Bekhterev, O. S. Bokastova, A. N.

Abramov, V. L. Pokotilo, A. P. Crimea, M. N. Volkovich et al.

In 1916 at the XIV congress/descent of russian surgeons with the report about the readings to the surgical treatment of the bullet wounds of spine and spinal cord spoke V. L. Pokotilo, who reported 25 laminectomies with the fatal result in 16 wounded. Lecturer persistently recommended the active methods of treatment, considering the best period for the operation/process the first two weeks after wound. It supported N. N. Petrov, A. A. Oshman et al. After this congress/descent changed the views on the surgical tactics with the wounds of spine toward an increase in the activity. However, deficiencies/lacks in the organization of the medical and sanitary service in the tsarist army, deficiency of a total number of experienced surgeons led to the fact that in the first world war the treatment of the wounds of spine and spinal cord was conducted mainly in the deep rear where these wounded deposited for a long time. In this case bulk of heavily wounded perished in the foremost stages of evacuation from different infectious and tropho-paralytic complications. Thus, in the first world war Russian surgeons (as foreign) could not reveal sufficient surgical activity in the treatment of the bullet wounds of spine and spinal cord, although they operated comparatively more than in the previous wars (N. N. Burdenko, L. M. Pussep, A. Pensky, V. L. Pokotilo, D. P. Kuznetskiy and many others).

The neuropathologists of that time were more frequently the supporters of the conservative treatment of the bullet wounds of spine and spinal cord (V. E. Dzerzhinskiy). Even actively adjusted surgeons in connection with that pointed out above had available a comparatively insignificant number of observations. Thus, A. P. Finkov gave 11 observations, A. V. Martynov and Ye. P. Kononova - 20 observations, A. Pensky - 28, V. L. Pokotilo - 34 and D. P. Kuznetskiy - 24 observations. Separate observations published A. L. Polenov, P. A. Herzen, V. I. Dobrotvorskiy, N. N. Lebedev, P. G. Kornev et al.

The little activity of the surgeons in the treatment of the bullet wounds of spine in the first world war led to the fact that also toward the end of the war was not formed any sharp installations for determining of readings and contraindications to surgical intervention, or periods and volume of the latter with such wounds.

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Only of the afterward great October Socialist Revolution in our country underwent wide development the neurosurgery, which was rapidly designed as independent discipline. Since 1921 are organized

individual neuro-surgical clinics, and somewhat later and neuro-surgical institutes. In 1934 is created neuro-surgical advice/council with the Moscow neuro-surgical institute of Narkomzdrav (People's Commissariat of Public Health) of the USSR, which coordinated scientific research and practical work in the region of neurosurgery, while in 1935 were organized the first departments for neurosurgery with the Institutes of the Continuing Education of the doctors. In the same year is published the first leadership/manual on the neurosurgery (edited by A. L. Polenova). Through two years (in 1937) appeared the first in the world special periodic journal "Questions of neurosurgery" (responsible editor N. N. Burdenko).

Entire presented contributed to the rapid progress of neurosurgery, to the training of personnel of the neurosurgeons and, in particular, to the development of the urgent questions of theory and practice of the injury of nervous system, including spine and spinal cord.

In 1934 A. Yu. Sozon-Rzowevi in the experimental work on the dogs showed the advantage of early radical primary processing to laminectomy inclusively with the bullet wounds of spine.

In 1935 A. N. Bakulev recommended within the early periods

(first 8 hours) the radical primary processing of the wound of spine and spinal cord with subsequent stitching of wound tightly. Within the later periods was recommended the same processing, but without stitching.

In spite of completely convincing data in favor of early radical surgical intervention with the bullet wounds of spine with the damage of spinal cord, nevertheless and in later military collisions - in Khasan lake (1938) and on Khalkhin-Gol river (1939) - was noted the restrained attitude of the individual surgeons toward the surgical treatment of the wounds of spine and spinal cord with the high surgical activity in the relation to the wounds of other regions of body (M. N. Akhutin).

In the war with White Finns (1939-1940), in connection with sanitary-tactical special features/peculiarities of front (nearness of Leningrad with its wide net/system of neuro-surgical institutions), wounded into the spine were concentrated in specialized institutions where there is exerted early radical neuro-surgical by aid.

At the special conference in Leningrad 5/IV 1940, dedicated to questions of the bullet wounds of spine and spinal cord, in the reports of A. L. Polenov, I. Ya. Razdol'skiy, A. V. Bondaruchk and V.

I. Loyko et al. were represented the results of the surgical treatment of the wounds of spine and spinal cord. In all reports unanimously was underscored the advisability of the surgical treatment of these wounds. It was there established/installed, which prognosis stands in direct connection/communication with the periods of surgical intervention and becomes more favorable, the earlier is produced laminectomy. This point of view was supported both by other Leningrad neuropathologists and neurosurgeons.

However, individual surgeons continued to adhere to expectant tactics in questions of the surgical treatment of those wounded the spine and the spinal cord, depositing intervention before the refinement of neurologic diagnosis.

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Within the time of war with the White Finns underwent review also a question about the primary processing of the wounds of spine and spinal cord in the army area. In the beginning of combat operations such wounds underwent primary surgical processing in the therapeutic institutions of army area. Frequently wounds cut excessively widely, without taking into account possible surgical intervention on the spine subsequently. Sometimes of wound after the primary processing of soft tissues they sewed tightly, to what

energetically retorted A. L. Polenov, P. A. Cyprian et al.

It is later, in accordance with the special instructions of the sanitary control of Leningrad military district, the surgeons in the army area were limited only to dress/lavatory of wounds (Ye. F. Nikul'chenko, N. A. Dashkovskiy, M. I. Fidel'man), evacuating such wounded into the hospitals of GBF, where after careful neurologic investigation and their necessary X-ray analysis they subjected to radical surgical intervention.

As a result of the small experience, obtained in the war with the White Finns, was outlined distinct shift/shear in surgeons' views in favor of larger activity in the treatment of the bullet wounds of spine and spinal cord and, on M. N. Burdenko's statement, solidly were formed general/common/total installations in questions of the organization of neuro-surgical aid by wounded. Neurosurgery engaged its place in the system of the medical service of the Red Army. At the same time were formed representations also about the advisability of approaching the neuro-surgical aid to wounded.

Thus, at the beginning of the Great Patriotic War 1941-1945. The military medical service of the Red Army arrived with the specific experiment/experience in the treatment of the neuro-surgical wounded, including wounded the spine and the spinal cord.

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Chapter II.

CLASSIFICATION AND FREQUENCY OF BULLET WOUNDS OF THE SPINE AND SPINAL CORD.

Candidate of medical sciences docent D. G. Gol'dberg and  
corresponding member of the Academy of Medical Sciences of the USSR  
Honored Scientist professor I. Ya. Razdol'skiy.

The classification of bullet wounds and damages of spine and spinal cord must aid systematization and reduction into the ordered system of entire diversity of damages, especially bullet wounds, which are encountered in the wartime. This classification facilitates the recognition of the separate means of wounds and damages (diagnosis) and thereby it helps correct classification and evacuation of casualties from the designation/purpose, determination of the rational methods of treatment and finally to correct account and to study of such wounds and damages.



All combat wounds and damages of spine and spinal cord in accordance with up to now the general-surgical principles accepted are divided into three groups: 1) bullet wounds, 2) puncture and cut wounds, 3) the closed damages.

The first two groups are characterized by the presence of wound, which always threatens by the dissemination of infection depthward to spine and contents of spinal canal.

Within the time of the Great Patriotic War were encountered almost exclusively bullet wounds. As rare exclusions were noted the puncture and cut wounds, obtained in the hand-to-hand fighting.

This means of wounds was encountered so rarely, which about them is not mentioned not only in the separate shapes, but also in the monographs and special collections, which left during the Great Patriotic War and after it, as it is not mentioned about them in the majority of the medical reports of fronts and armies. Neurologic violations with the puncture and cut wounds more frequently were expressed in the Brown-Sequard syndrome. Such casualties in the single cases only underwent surgical treatment.

The closed damages composed only 0.20/o of all battle damages of spine. From classification and statistical data are given in the VII

chapter (special unit), dedicated to the analysis of the closed damages of spine. This relationship/ratio of the battle damages of spine is explained by the saturation of combat operations/processes weapons, what is the special feature/peculiarity of modern wars, in particular, the Great Patriotic War.

It suffices for the comparison to cite data on the Caucasian and Danube army in the Russo-Turkish war 1877-1878 (Table 1).

From table 1 it is evident that in the Caucasian army of the wound of spine by silent weapon they achieved 3.00/o, and the closed damages - 9.40/o. This is completely understandable, because in the previous wars the combat operations/processes more frequently reached the hand-to-hand ones or interlocks, in which the significant role played silent weapon.

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To the Great Patriotic War and in the beginning its attempts to create the classification which would reflect simultaneously the wounds also of spine, and spinal cord, little satisfied neurosurgeons and neuropathologists.

The construction of the single classification of the bullet

wounds of spine and spinal cord runs into the series/number of difficulties as a result of the fact that the damages of spine and spinal cord can be observed both separately and in different combinations, besides different severity. It is always necessary to consider that the frequently straight/direct parallelism between the severity of the damage of spine and the severity of the damage of spinal cord there is not.

According to the conventional classification, all wounds of spine are divided as follows:

A. On the level of the equalization:

1. Wounds of neck division.
2. Wounds of thoracic division.
3. Wound of lumbar division.
4. Wounds of sacral division.

This differentiation is important in connection with the characteristic clinical neurologic picture detected for each level of the wound of spine.

B. According to form/species of wounding weapon:

1. bullet.

2. Fragmentation (fragments of shells, min, aviation bomb).

C. Further are distinguished wounds:

1. Isolated/insulated.

2. Combined, or combined, with which simultaneously with spine the same shell ranite and other tissues and organs/controls of neck, chest, abdominal area, etc.

3. Set of wound of spine, with which spine is wounded simultaneously by several shells at different levels.

D. By mechanism of wound:

1. Through.

2. Blind.

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### 3. Tangents.

In the given classification has in mind the character/nature of the wound of the spinal column and contained spinal canal.

Table 1. Frequency of different wounds and damages of spinal column during the Russo-Turkish war 1877-1878 (in the absolute numerals).

(1) Лечебные учреждения армии	(2) Ранения			(6) Ушибы от огне- стрельных снарядов	(7) Повреж- дения и другие причины	(8) Всего
	(3) Холодным оружием	(4) Пулями	(5) Осколками и другими снарядами			
(9) Все лечебные учреждения Кавказской армии	26	703	41	37	44	851
(10) Подвижные и неподвижные полевые госпитали Дунайской армии	12	376	314	19	44	765

Key: (1). Therapeutic institutions of armies. (2). Wounds. (3). cold weapon. (4). bullet. (5). by fragments of large/coarse shells. (6). Contusions from bullet shells. (7). Injuries and other reasons. (8). In all. (9). All therapeutic institutions of Caucasian army. (10). Mobile/motile division field hospitals of Danube army.

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It is virtually especially important to explain the character/nature of the wound of the contained spinal canal, since the severity of wound, the methods of treatment and prognosis in the absolute majority of the cases depend not so much on the damage of spine, as from the damage of the contained spinal canal. As is evident it will be further, the experiment/experience of the Great Patriotic War showed that between the character/nature of the wound of spine and the severity of the damage of the contained spinal canal are known

regular relationships/ratios.

E. By character/nature of wound of spine and spinal canal they distinguish:

1. Penetrating wounds.

2. Nonpenetrating wounds.

3. Bullet damages of contained spinal canal without damage of spine, or paravertebral wounds.

To the Great Patriotic War the wounds of spine did not subdivide into those penetrating and nonpenetrating ones.

Although V. L. Pokotilo as early as 1913 gave the sharp definition of the penetrating wound of spine as the wound, which penetrates into the spinal canal, i.e., the escorted/tracked by the damage of walls spinal canal, unfortunately, this characteristic of the penetrating wound was forgotten.

Only in 1941, on the instruction of main sanitary administration of the Red Army, in the reports and the account were connected these designations, although the concrete decoding of the

content of these concepts it was not given.

The accepted, on N. N. Petrov's proposition, interpretation of the penetrating wound of skull as the wound, which is escorted/tracked by the damage of solid cerebral shell, for the wounds of spine proved to be unacceptable, since the damage of the solid cerebral shell of spinal cord, with rare exception, can be established/installed only during the operation/process or even on the autopsy. To solution of this question frequently cannot aid X-ray analysis, since solid cerebral shell even in the presence of foreign body in the spinal canal can prove to be safe and, on the contrary, can prove to be that damaged by the wounding shell or fine bone fragments, which yield either clinical or to roentgenological determination.

The experiment/experience of the Great Patriotic War showed that the point of view of V. L. Pokotilo and is at present singularly correct and is confirmed by the experiment/experience of latter/last years.

The given below classification, constructed on the basis of clinico-rentgenoanatomical investigations by N. S. Kosinskaya, was applied in the series/number of fronts (Leningrad, Volkhov, Karelian, northern), and it is later in the number of the therapeutic



institutions of the 1st Ukrainian, 2nd Belorussian and other fronts and, as showed experiment/experience, it completely itself justified.

According to the investigations by N. S. Kosinskaya, all gun wounds of spine with respect to the direction of wound canal with respect to the spine and to spinal canal are divided into five types (Fig. 1).

With I type of wounds wound canal crosses/intersects spinal canal, i.e., the wounding shell passes through the spinal canal (Fig. 1, I).

With the II type of wounds wound canal is finished in the spinal canal, i.e., the wounding shell is detained in the spinal canal (Fig. 1, II).

With the III type wound canal destroys (it reveals) the walls of spinal canal, but does not penetrate depthward canal (Fig. 1 III). More frequent with this type of wounds there are damaged the small arcs of vertebrae.

With IV type wounds wound canal is passed out of the spinal canal, moreover are damaged only those divisions of spine, which do not accept participation in the formation of the walls of spinal

canal (Fig. 1, IV).

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With this type of wounds usually are damaged the bodies of vertebrae, awned or cross extensions with the retention/preservation/maintaining of small arcs or, it is rare, with their sulcate wound, without the autopsy of spinal canal.

With the V type wound canal is passed out of the spine (Fig. 1, V), in this case are wounded near-spinal tissues, and spinal cord, its shells, vessels and rootlets damages by transmission shock, as a result of the damage of edges/fins, bones of pelvis, nerve webes/plexi or as a result of the jolt of spine by the wounding shell of large force, which passes near from the spine.

Recognizing together with V. L. Pokotilo the wounds, which are escorted/tracked by the autopsy of the walls of spinal canal, by the penetrating wounds of spine, to them should be related the first three types of the wounds of N. S. Kosinskaya's scheme - perforating, blind and tangential wounds of spinal canal.

The nonpenetrating wounds of spine include IV type wounds, to the paravertebral ones - V type wounds.

This treatment of the penetrating wound of spine finds its basis in the following:

1. As noted above, with clinical (including X-ray analysis) methods of study it is not possible to establish/install the presence of the damage of the internal leaflet of solid cerebral shell. Exclusion present only relatively rare cases of wounds, which are escorted/tracked by external liquorrhea or during the detection of the large/coarse foreign body, which fills entire spinal canal.

2. During damage of bone walls of spinal canal, as a rule, are wounded external leaflet of solid cerebral shell, lining/covering spinal canal its from within and considered by some anatomists as endosteum.

3. During damage of walls (autopsy) of spinal canal are created favorable conditions for infection of shells and spinal cord. The danger in the infection even more is raised during the violation of the integrity of the internal leaflet of solid cerebral shell.

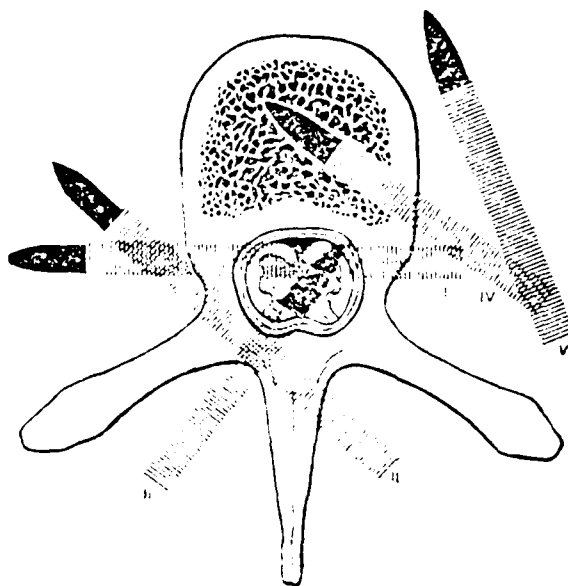


Fig. 1. Diagrammatic representation of the types of wound canals with the bullet wounds of spine and spinal cord.

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The given clinical-surgical and roentgenological characteristic of wounds made it possible to put into the ordered system entire diversity of the wounds of spine, and taking into account the neurologic violations, which are observed with them (about which see below), to construct the classification, which reflects the character/nature of the damage of spine and the degree of the violation of the conductivity of spinal cord or rootlets of horse tail, i.e., making it possible to judge the severity of wounds and

the resultant necessary measures.

Is given below the single neuro-surgical classification of the bullet wounds of spine and spinal cord, based on the data of a clinico-surgical x-ray and neurologic examination of casualty.

Classification of the bullet wounds of spine and spinal cord.

A. Penetrating wounds of spine.

1. Perforating penetrating wounds of spine (I type according to N. S. Kosinskaya):

a) with full/total/complete violation of conductivity of spinal cord or rootlets of horse tail;

b) with partial violation of conductivity of spinal cord or rootlets of horse tail;

c) without neurologic violations.

2. Blind penetrating wounds of spine (II type according to N. S. Kosinskaya):

a) with full/total/complete violation of conductivity of spinal cord or rootlets of horse tail;

b) with partial violation of conductivity of spinal cord or rootlets of horse tail;

c) without neurologic violations.

3. Tangential penetrating wounds of spine (III type according to N. S. Kosinskaya):

a) with full/total/complete violation of conductivity of spinal cord or rootlets of horse tail;

b) with partial violation of conductivity of spinal cord or rootlets of horse tail;

c) without neurological violations.

B. Nonpenetrating wounds of spine (IV type according to N. S. Kosinskaya).

1. Perforating nonpenetrating wounds:

a) with full/total/complete violation of conductivity of spinal cord or rootlets of horse tail;

b) with partial violation of conductivity of spinal cord or rootlets of horse tail;

c) without neurologic violations.

2. Blind nonpenetrating wounds:

a) with full/total/complete violation of conductivity of spinal cord or rootlets of horse tail;

b) with partial disruption of conductivity of spinal cord or rootlets of horse tail;

c) without neurological violations.

3. Tangential nonpenetrating wounds:

a) with full/total/complete violation of conductivity of spinal cord or rootlets of horse tail;

b) with partial violation of conductivity of spinal cord or

rootlets of horse tail;

c) without neurologic violations.

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C. Paravertebral wounds<sup>1</sup> (V type according to N. S. Kosinskaya):

a) with full/total/complete violation of conductivity of spinal cord or rootlets of horse tail;

b) with partial violation of conductivity of spinal cord or rootlets of horse tail.

Graphically this classification is shown in Fig. 2.

FOOTNOTE <sup>1</sup>. Without depending on presence or absence of bone damages (in the edges/fins, bones of pelvis, etc.), paravertebral wounds without the neurologic violations not relate to neuro-surgical wounds and in the present section of "work" are not examined. ENDFOOTNOTE.

Graphically this classification is shown in Fig. 2.

Differentiation of wounds according to the type of the wounding



weapon, on the level of the wound of spine, on presence or absence of the associated wounds of other organs/controls is carried out beyond the frames/scopes of classification and finds direct reflection in the diagnosis of wound.

At the beginning of the Great Patriotic War of neurologic classification, which would cover all clinical forms of the bullet wounds of spinal cord and its rootlets, there did not exist. The most complete classification belonged to M. S. Skoblo (1936), but it, apparently was unknown to the wide circles of the neuropathologists, since the overwhelming majority of the neuropathologists it did not put to use. Even in the specialized neuro-surgical hospitals diagnosis was placed in most common format: "the bullet damage of spinal cord" with the partial or full/total/complete violation of conductivity, the "damage of horse tail". In the course of war grew the urgent necessity for the refinement of the character/nature of the damage of spinal cord and its rootlets. In connection with this a number of the authors proposed new classifications. However, in them the diversity of the clinical forms of the damages/defects of brain did not find its full/total/complete representation.

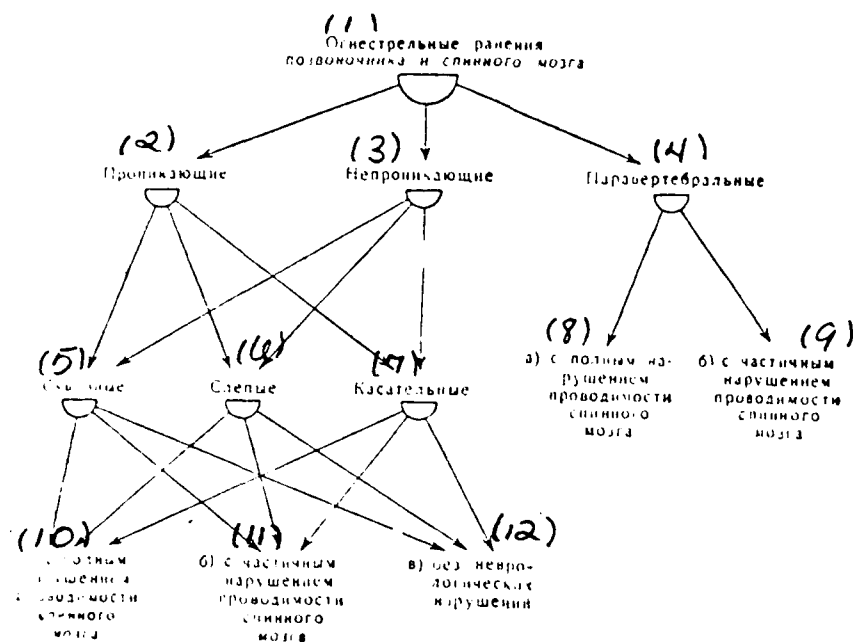


Fig. 2. Bullet wounds of spine and spinal cord.

Key: (1). Bullet wounds of spine and spinal cord. (2). Penetrating. (3). Nonpenetrating. (4). Paravertebral. (5). Through. (6). Blind. (7). Tangents. (8). a) with full/total/complete violation of conductivity of spinal cord. (9). b) with partial violation of conductivity of spinal cord. (10). a) with full/total/complete violation of conductivity of spinal cord. (11). b) with partial violation of conductivity of spinal cord. (12). c) without neurologic violations.

Z. I. Geymanovich's classification characterizes in essence not the clinical forms of the damages/defeats of brain, but the mechanism of his damage. In accordance with this it secretes two basic types of the damages/defeats of the brain: a) its contact trauma and b) transmission trauma with their further subdivision.

The classification, proposed by G. P. Kornyskiy, can satisfy surgeon, but not neuropathologist; the neurologic manifestations of damage/defeat are determined in it too generally: the "damage/defeat of spinal cord or its rootlets", the "damage/defeat of spinal cord with the mechanical violation of its substance" and the like.

G. D. Aronovich's classification expects the expanded/scanned characteristic only of spinal-root violations, besides mainly with the nonpenetrating wounds of spine.

In N. S. Chetverikov's classification, on one hand, there is no jolt and contusion of the spinal cord, and on the other hand - with it is connected suppurative meningitis, which is not the basic form of the bullet damage/defeat of brain, but its complication.

On the basis of the account of Soviet neuropathologists'

experience in the Great Patriotic War as the neurologic classification, which most completely reflects the diversity of the clinical forms of bullet damages of spinal cord, it is possible to recognize the following<sup>1</sup>:

Jolt of spinal cord.

FOOTNOTE <sup>1</sup>. Symptomatology and diagnosis of the below-indicated forms of damages/defeats are given in the IV and V chapter of this section.  
ENDFOOTNOTE.

Contusion, crushing of spinal cord (or horse tail).

Wound of spinal cord (or horse tail).

Hematomyelia.

Hematoma is epidural.

Sub-arachnoidal hemorrhage.

Traumatic radiculitis.

All these clinical forms, with exception of the first and the

latter, can be escorted/tracked by the compression of spinal cord and horse tail.

The observed complications of the bullet damages of spinal cord and its shells can be subdivided into the following basic forms:

general/common/total suppurative spinal meningitis.

Restricted spinal suppurative meningitis.

Suppurative meningomyelitis.

Sharp/acute suppurative spinal pachymeningitis.

Abscess epidural, subdural, intra-medullary.

Chronic spinal pachymeningitis.

Arachnoiditis of spinal cord.

Recognition of the majority of the mentioned clinical forms is possible only on the basis of the careful neurologic and clinico-surgical investigation, supplemented by data of X-ray analysis, and in the case of laminectomy, by data discovered on the

operation/process. War experience showed that this was possibly only in the specialized neuro-surgical agencies. In the general-surgical hospitals, but more in the foremost stages of evacuation the correct recognition of many of these clinical forms is not always possible. Therefore primary task of these institutions must be the recognition of the presence of the damage/defeat of spinal cord and the establishment of the severity of the violation of its function.

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The recognition of the severity of the violation of the function of spinal cord is decisive for the clinical estimation of wound, its prognosis and treatment. It is available not only to neurosurgeons and neuropathologists, but also to surgeons. Virtually completely it suffices to establish/install the presence of the partial or full/total/complete violation of the conductivity of spinal cord. Therefore the given above neuro-surgical classification is constructed taking into account in essence only these two forms of neurologic characteristic. In the specialized neuro-surgical agencies it is necessary to indicate also clinical form.

Thus, for the specialized hospital of army or front line area basic problem it is: 1) to establish/install the severity of the damage of spinal cord or horse tail, 2) to recognize the

character/nature of damage, 3) to come to light/detect/expose presence or absence of compression, 4) to determine basic the clinical forms of the damage/defeat of spinal cord even 5) to recognize the early forms of complications. During the radical perfecting of wound, including in the case of necessity laminectomy, clinical diagnosis must be refined on the basis of data revealed with surgical intervention.

Frequency of wounds (general/common/total statistical data).

In the mid XIX century N. I. Pirogov determined the frequency of the wounds of back canal and spinal column" into 3.0-4.0o/o to a total number of wounds. But by official data of the sanitary service of German army in the first world war 1914-1918, the wound into the spine composed 0.53o/o, including with the damage of spinal cord - 0.3o/o [Franz], the subject of American sanitary service, with respect 0.2 and 0.12o/o, and according to the data of French sanitary service, 1.7 and 0.17o/c.

Individual Russian surgeons communicated about 1.0-2.0o/o (V. I. Dobratvorskiy, N. N. Samarin) and 1.95o/o (N. S. Mokin, according to the data of Army of Southwestern Front). Almost analogous percentage gave M. N. Akhutin based on materials of combat in Khasan lake (1938), namely 1.5.

Within the time of war with White Finns (1939-1940) P. A. Cyprian determined the frequency of the bullet wounds of spine and spinal cord into 1.50/o. Based on materials of the development of the histories of disease/sickness/illness/malady, which relate to different fronts and large-scale combat operations/processes, and also to the front sectors with the relative calm between the large combat operations/processes, the frequency of the bullet wounds of spine and spinal cord within the time of the Great Patriotic War oscillated in limits of 0.3-1.50/o, depending on the character/nature of combat operations/processes (S. S. Girgolav).

One should be specified that in entire subsequent presentation to avoid excessive repetition the statistical evidence, obtained based on materials of the development of the histories of the disease/sickness/illness/malady of the medical museum of the Ministry of the armed forces of the USSR, will be brought, with rare exception, without the indications of the source of obtaining these numerals. In all cases of the use of statistical evidence from other sources, somehow: the materials of the protocols of autopsies, different reports, materials of the personal observations of the individual authors, etc., the source of the obtained information will be specified particularly.



According to the type of the wounding weapon. Although in the first world war the saturation by artillery and mortar fire was sufficiently great, nevertheless, according to the data of authors' majority, bullet wounds predominated above the fragmentation ones. Thus, according to V. I. Dobrotvorskiy's data, the bullet wounds of spine were encountered almost into 2/3 cases.

In the Great Patriotic War noticeably predominated the wounds fragmentation.

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Of all battle damages of spine on the bullet wounds fall 42.50/o, to the fragmentation ones - 57.30/o and to the closed damages - 0.20/o. These numerals varied in the considerable limits at different authors, depending on working conditions for their. Thus, K. G. Terian (GBA, 1943) could note the fragmentation wounds of spine into 53.00/o and bullet ones - into 47.00/o of cases, N. I. Grashchenkov observed in 1942 (defensive actions) fragmentation wounds into 68.80/o, bullet - into 22.50/o, the closed damages of spine - into 8.70/o, and in 1943 (offensive combat) respectively - 50.0-41.1-8.90/o. Based on materials of GBF (1945), among the bullet

wounds of spine on the fragmentation wounds fall 55.0o/o, and to the bullet ones - 45.0o/o.

The relationship/ratio of bullet and fragmentation wounds depends to a considerable degree on the character/nature of combat operations/processes. So, under conditions of active defense in plain predominated fragmentation wounds, while with the onset, especially in its initial phase, noticeably was increased a number of bullet wounds. Under conditions for the large offensive operations, connected with the penetration of front and the pursuit of enemy, again began to predominate fragmentation wounds, although it is insignificant. According to the character/nature of wound among the fragmentation ones predominated blind, and among the bullet ones - perforating wounds, which is explained by the kinetic and ballistic special features/peculiarities of the wounding shells.

The power of contemporary gun and machine-gun bullet with its streamlined shape is so great, that only the wounds at the distant distance, on the takeoff of bullet or rebounding wounds can remain blind, when bullet, after meeting bone or even with the elastic soft tissues, stops before them. Inverse relations are characteristic for the fragmentation wounds. Based on materials of GBF, among the blind wounds of spine on the bullet wounds fall 28.3o/o, and to the fragmentation ones - 71.7o/o. Similar data gives, based on materials

of other fronts, M. P. Postolov, A. S. Orlovskiy et al.

The wounding shell to a considerable extent determined mechanism and character/nature of the wound of spine and spinal cord (table 2).

From table 2 it is evident that among the bullet penetrating wounds through were encountered almost 2 times more frequently than among the fragmentation ones, and blind, on the contrary, were observed 2 1/2 times more frequently among the fragmentation ones.

With the bullet wounds wound canal passed primarily to the frontal plane (sboku or on the side and from behind), while with the fragmentation ones - in the sagittal plane (from behind or from behind and on the side).

The wounds of spine in the sagittal plane, with the direction of wound canal from the front back/ago, in the hospital net/system were encountered relatively rarely, since the majority of such casualties perished on the field of battle as a result of the heavy combined wound of the organs/controls of thoracic or abdominal area.

Table 2. Character/nature of the wounds of spine depending on the form/species of the wounding shell.

(1) Ранения снаряд	(2) Проникающие ранения			(6) Непроникающие ранения	(7) Паравертебральные ранения	(8) Характер ранения не выяснен
	(3) сквозные	(4) слепые	(5) касательные			
(9) Пуля	16,4	6,5	18,5	55,9	1,0	1,7
(10) Обломок	9,2	15,1	18,5	54,9	1,1	1,2

Key: (1). Wounding shell. (2). Penetrating wounds. (3). through. (4). blind. (5). tangents. (6). Nonpenetrating wounds. (7). Paravertebral wounds. (8). Character/nature of wound not explained. (9). Bullet. (10). Fragment.

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The severity of the damage of the contained spinal canal affects also the size/dimension of fragment, which is evident during the comparison of the severity of the damage of spinal cord with the wounds by the fragments of artillery shells and by the fragments of mines (Table 3).

From table 3 it is evident that the heavy damages of spinal cord relatively more frequently were encountered with the wounds by the fragments of artillery shells and aircraft bombs, than with multi-fragment wounds.

Localization of foreign bodies with the blind-end wounds is given in Table 4.

From Table 4 it is evident that:

1) foreign bodies were encountered in 57.60/o all of those operated;

2) relative to frequently were encountered foreign bodies in the bodies of vertebrae, especially in lumbar division (6.20/o), in spinal canal (8.30/o) and even in intervertebral foramen (1.50/o);

3) most frequently (3.190/o) foreign bodies drove out from the paravertebral divisions when wounding shell, after consuming wounding shell, after consuming its living Seeley's its in soft tissue, usually near the place of the break of spine.

Table 3. Severity of the damages of spinal cord with the wounds by different fragments (in the percentages to the result according to each form/species of shells).

(1) Неврологический синдром	(2) Осколки		
	(3) мин	(4) артиллерийских снарядов	(5) авиабомб
(6) Без неврологических нарушений или скоропреходящих нарушений	26,7	29,9	22,0
(7) Полное нарушение проводимости спинного мозга	25,6	30,9	30,0
(8) Частичное нарушение проводимости спинного мозга	37,7	39,2	38,0
(9) Итого	100,0	100,0	100,0

Key: (1). Neurologic syndrome. (2). Fragments. (3). min. (4). artillery shells. (5). aircraft bombs. (6). Without neurologic violations or transitory violations. (7). Full/total/complete violation of conductivity of spinal cord. (8). Partial violation of conductivity of spinal cord. (9). Altogether.

Table 4. Localization foreign bodies with the bullet wounds of spine on the level of wound in operational casualties (in the percentages to all those operated).

(1) Локализация инородных тел	(2) Уровни ранений			(6) Всего
	(3) шея отдел	(4) грудной отдел	(5) поясничный отдел	
(7) в дужках и отростках . . . . .	4,3	2,4	4,0	3,5
(8) в межпозвоночных отверстиях . . . . .	1,1	1,1	1,8	1,5
(9) в теле позвонка . . . . .	5,1	5,6	6,2	5,7
(10) в позвоночном канале:				
(11) экстрадурально . . . . .	2,9	4,5	5,0	4,4
(12) субдурально . . . . .	1,3	6,2	3,3	3,9
(13) Паравертебрально . . . . .	39,2	28,6	31,9	31,9
(14) в других органах . . . . .	6,4	8,0	6,0	6,7
(15) Иностранные тела отсутствовали . . . . .	39,7	43,6	41,8	42,4
(16) Итого . . . . .	100,0	100,0	100,0	100,0

Key: (1). Localization of foreign bodies. (2). Level of wounds. (3). neck division. (4). thoracic division. (5). lumbar division. (6). In all. (7). In small arcs and extensions. (8). In intervertebral foramens. (9). In body of vertebra. (10). In spinal canal. (11). it is extradural. (12). it is subdural. (13). It is paravertebral. (14). In other organs/controls. (15). Foreign bodies were absent. (16). Altogether.

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The frequency of the wounds of spine at its different levels in the Great Patriotic War is represented in Fig. 3.

The preponderance of the wounds of the thoracic division of spine can be explained by its larger extent.

In proportion to the advance of casualties from the front into the rear changed the relationship/ratio of a number of casualties, who obtained the wounds of one or the other divisions of spine. This was conditioned on the fact that with the wounds of different divisions of spine the lethality at the front and in the rear was different. On the field of battle and in the nearest stages of evacuation perished the relatively larger percentage of casualties with the damage of the neck division of spine, while in the more distant stages - with the wounds of thoracic, and then lumbar-sacral division. This law distinctly comes forward in the examination of those relating it comes forward in the examination of the relating to different stages of evacuation statistical data individual authors (Table 5).

According to the character/nature of wound within the time of the Great Patriotic War nonpenetrating and paravertebral wounds were observed into 43.80/o, the penetrating wounds into 56.20/o.

Among the wounds of different divisions of spine the penetrating and nonpenetrating wounds are distributed as follows (Fig. 4).



Thus, among the wounds of neck and lumbar-sacral division of spine under hospital conditions predominated nonpenetrating; on the contrary, among the wounds of thoracic division sharply (2 times) predominated the penetrating wounds.

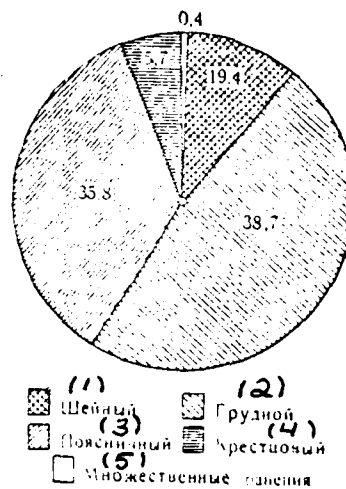


Fig. 3. Frequency of the wounds of different divisions of spine.

Key: (1). Neck. (2). Thoracic. (3). Lumbar. (4). Sacral. (5). Multiple wounds.

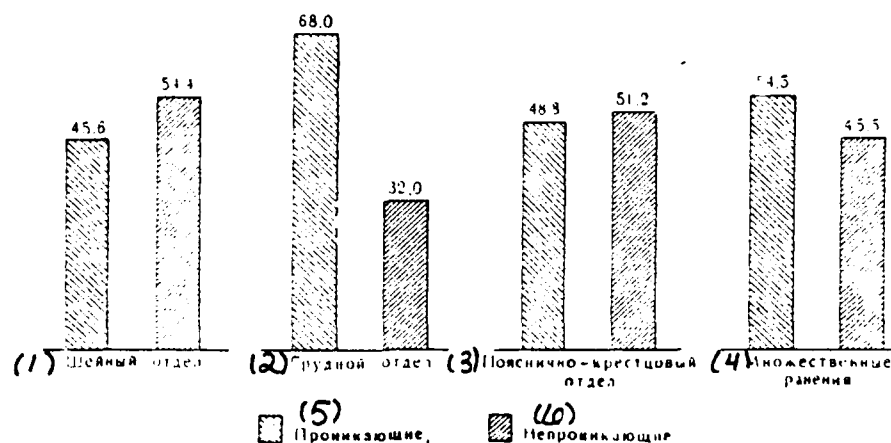


Fig. 4. Distribution of the penetrating and nonpenetrating wounds in the dependence on the level of the damage of spine.

Key: (1). Neck division. (2). Thoracic division. (3). Lumbar-sacral division. (4). Multiple wounds. (5). Penetrating. (6). Nonpenetrating.

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The preponderance of nonpenetrating wounds among those wounded the neck division of spine can be explained by the fact that the obtained heavy penetrating wounds of the neck division of spine more frequently perished on the field of battle.

For the penetrating and nonpenetrating wounds of spine neurologic violations are separately distributed as follows (Fig. 5).

Table 5. Distribution of the wounds of spine according to the levels in different stages of evacuation (according to the observations of different authors).

(1) Автор	(2) Этап наблюдений	(3) Уровень ранения позвоночника (в процентах)		
		(4) шейный	(5) грудной	(6) пояснично-крестцовый
(7) А. Н. Бакулев	(8) Фронтальной район	16,5	31,3	52,2
(9) Д. Г. Гольдберг	(10) То же	18,7	33,5	42,8
(11) К. Г. Терлан	(12) Армейский район	14,5	58,0	27,5
(13) Б. И. Рапопорт	(14) Глубокий тыл	10,6	29,1	60,3

Key: (1). Author. (2). Stage of observation. (3). Level of wound of spine (in percentages). (4). neck. (5). thoracic. (6). lumbar-sacral. (7). A. N. Bakulev. (8). Front line area. (9). D. G. Goldberg. (10). The same. (11). K. G. Terlan. (12). Army area. (13). B. I. Rapoport. (14). Deep rear.

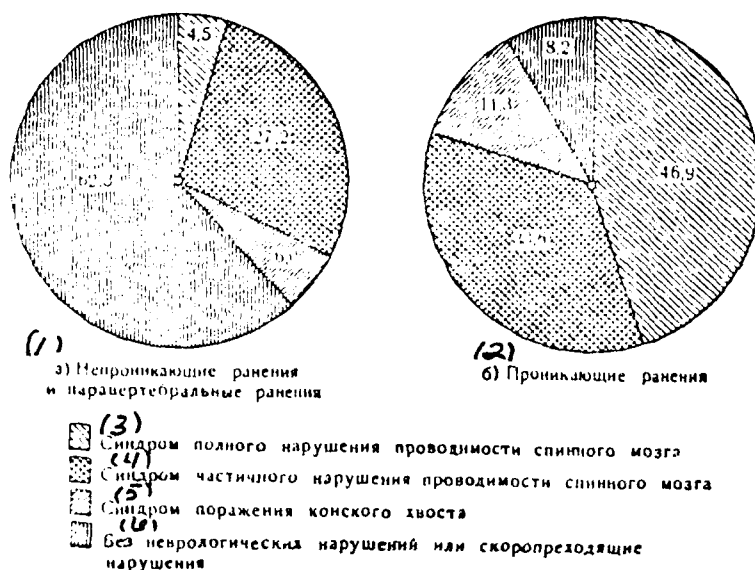


Fig. 5. Neurologic violations in the dependence on the character/nature of wound.

Key: (1). nonpenetrating wounds and paravertebral wounds. (2). Penetrating wounds. (3). Syndrome of full/total/complete violation of conductivity of spinal cord. (4). Syndrome of partial violation of conductivity of spinal cord. (5). Syndrome of damage/defeat of horse tail. (6). Without neurologic violations or transitory violations.

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Laws governing the relationships/ratios of neurologic violations and character/nature of the wound are completely obvious. For this it suffices to compare the frequency of the cases without neurological violations and the cases with the syndrome of the full/total/complete violation of the conductivity of spinal cord among the penetrating

and nonpenetrating wounds of spine.

One should consider that on the severity of neurological violations as according to the character/nature of wound, the relationship/ratio of frequency of different wounds varied greatly depending on the stages of evacuation. Most heavily casualties frequently perished in the foremost stages of evacuation, most easily wounded the spine, especially without the neurologic violations, they were scattered on general-surgery hospitals or even were headed in GLR.

As illustration can serve the analysis of the observations of the neuro-surgical hospital of Leningrad front.

According to the same data, the frequency of neurologic violations in the dependence on the character/nature of wound was distributed as follows (table 6).

The extremely low percentage of wounds without the neurologic violations is explained not only by the concentration of the most heavily casualties in the specialized hospitals of GBF, but also by an improvement in the diagnosis.

The distribution of wounds according to the severity of neurologic violations.

(1) Неврологические синдромы	(2) Процент среди всех ранений
(3) Синдром полного нарушения проводимости спинного мозга	27.0
(4) Синдром частичного нарушения проводимости спинного мозга	38.8
(5) Синдром полного нарушения проводимости конского хвоста с контузией конуса спинного мозга	5.5
(6) Синдром частичного нарушения проводимости конского хвоста	23.8
(7) Травматический радикулит	3.2
(8) Без неврологических нарушений	1.7
(9) Итого	100.0

Key: (1). Neurological syndromes. (2). Percent among all wounds. (3). Syndrome of full/total/complete violation of conductivity of spinal cord. (4). Syndrome of partial violation of conductivity of spinal cord. (5). Syndrome of full/total/complete violation of conductivity of horse tail with contusion of cone of spinal cord. ~~(5). Syndrome of full/total/complete violation of conductivity of horse tail with contusion cone of spinal cord.~~ (6). Syndrome of partial violation of conductivity of horse tail. (7). Traumatic radiculitis. (8). Without neurologic violations.

Table 6. Neurologic violations in the dependence on the character/nature of wound (in the percentages).

(1) Неврологические нарушения	(2) Ранения	
	(3) непроникающие	(4) проникающие
(5) Синдром полного нарушения проводимости спинного мозга	12,8	33,6
(6) Синдром частичного нарушения проводимости спинного мозга	51,0	33,1
(7) Синдром поражения конского хвоста	23,5	32,1
(8) Травматический радикулит	8,0	1,0
(9) Без неврологических нарушений	4,7	0,2
(10) Итого	100,0	100,0

Key: (1). Neurological violations. (2). Wounds. (3). nonpenetrating. (4). penetrating. (5) Syndrome of full/total/complete violation of conductivity of spinal cord. (6). Syndrome of partial disruption of conductivity of spinal cord. (7). Syndrome of damage/defeat of horse tail. (8). Traumatic radiculitis. (9). Without neurologic violations. (10). Altogether.

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From Table 6 it is evident that with the penetrating wounds the syndrome of the full/total/complete violation of the conductivity of spinal cord was encountered in GBF almost 3 times more frequently than with the nonpenetrating wounds. Radicular syndrome with the nonpenetrating wounds was noted 8 times more frequently than with those penetrating.



The wounds of spinal column without the noticeable neurologic violations with the penetrating wounds were encountered rarely.

The relationship/ratio of the character/nature of neurologic violations and character/nature of wounds can be seen from the analysis of the isolated/insulated wounds based on materials of the development of the histories of disease/sickness/illness/malady, given in Table 7.

Table 7 shows regular reduction in the severity of the damage of spinal cord, whereas beginning from through penetrating wounds and finishing with nonpenetration quantity of wounds of spine without the expressed neurologic violations and with the transitory violations, on the contrary, progressively it grows/rises, achieving 70.7o/o with the nonpenetrating wounds.

Among the wounds of spine were noted by 29.3o/o of those isolated/insulated, 70.3o/o of combined (combined) and by 0.4o/o multiple wounds. The frequency of the combined wounds is somewhat overstated due to the combination of the wounds of the soft tissues of body and extremities.

In more detail the character/nature of different combinations in the group of the combined wounds is examined below in the special unit (Chapter III). Here one should be specified that as the most serious combined wounds, which complicated treatment and which made prognosis worse, should be recognized the penetrating wounds of neck with the damage of vessels, esophagus and other organs/controls, which achieved by 3.40/o with the wounds of the neck division of spine, and also the penetrating wounds of the chest, which were encountered into 32.20/o with the wounds of the thoracic division of spine, and the abdominal area, noted into 6.90/o with the wounds of a lumbar-sacral division of spine. Such casualties required the complex observation of the neurosurgeon and other specialists (surgeon, otiatrist, etc.).

On the basis of the given data about the character/nature of the wounds of spine and neurologic violations with them it is possible to judge the severity of the wounds of spine and spinal cord, that were being observed during the Great Patriotic War.

Table 7. Relationship/ratio of neurological violations and character/nature of wounds (in the percentages).

(1) Характер ранения и неврологические нарушения	(2) Без неврологических нарушений или транзиторных нарушений	(3) Синдромы			(7) Всего
		(4) полное нарушение проводимости спинного мозга	(5) частичное нарушение проводимости спинного мозга	(6) повреждение конского хвоста	
(8) Сильные проникающие ранения позвоночника	2,0	63,6	21,4	13,0	100,0
(9) Слабые проникающие ранения позвоночника	0,6	43,9	29,0	25,6	100,0
(10) Поверхностные проникающие ранения позвоночника	12,9	22,8	39,0	25,3	100,0
(11) Непроникающие ранения позвоночника	70,7	2,4	20,5	6,4	100,0
(12) Паравертебральные ранения	9,7	17,4	65,2	16,7	100,0

Key: (1). Character/nature of wound and neurologic violations. (2). Without neurologic violations or transitory violations. (3). Syndromes. (4). full/total/complete violation of conductivity of spinal cord. (5). partial violation of conductivity of spinal cord. (6). damage of horse tail. (7). In all. (8). Perforating penetrating wounds of spine. (9). Blind-end penetrating wounds of spinal column. (10). Tangential penetrating wounds of spine. (11). nonpenetrating wounds of spine. (12). Paravertebral wounds.

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This is evident from the data of the frequency of penetrating wounds (56.20/o) and wounds with the syndrome of the full/total/complete

violation of the conductivity of spinal cord (30.7o/o), and together with the syndrome of the incomplete violation of the conductivity of spinal cord the frequency of these heavy wounds is increased to 58.4o/o.

The wounds of spine and spinal cord in the considerable a quantity of cases were burdened by different traumatic, tropho-paralytic and infectious complications.

For a nevertheless considerable number of these casualties it was possible to preserve life, and with the moderate/mild damages of spinal cord - and the health, because of the timely surgical measures, the physiotherapy and the treatment by sulfanilamides which in the past Great Patriotic War extensively were used in all stages of evacuation both with the preventive ones and for the therapeutic targets (sulfanilamides obtained 76.2o/o all of those wounded the spine).

Besides the primary surgical perfecting of the wound of soft tissues, 21.9o/o all of those wounded the spine underwent laminectomy - this level surgical activity achieved not in one of the previous wars. An increase in the radical operational aid by that wounded the spine should be ascribed organization in Soviet army of the wide net/system of the specialized neuro-surgical agencies and their

approximation/approach to casualty.

Without discussing fully the issues of the bullet wounds of spine and spinal cord, presented in detail in chapter VI of special unit, is appropriate to indicate here a reduction in the lethality with these wounds in the Great Patriotic War in comparison with the first world war. So, based on materials of the development of the histories of disease/sickness/illness/malady within the time of the Great Patriotic War general/common/total lethality with the wounds indicated composed 45.60/o, while in the first world war according to Russian and foreign authors' data, it achieved 80.00/o (N. N. Burdenko, Guyau, Duperier, etc.).

Concerning general/common/total issues, one should also indicate that, besides the wounds of spine without the neurologic violations during which the absolute majority of casualties preserved ability to work, about the half those wounded the spine with the damage of spinal cord or horse tail not only it survived, but majority of them to a greater or lesser extent preserved ability to work.

For such casualties the obtained issues should be recognized the satisfactory ones, and view on those wounded the spine with the damage of spinal cord as on the hopeless ones, widespread in the previous wars in Russian and foreign armies, should be recognized not substantiated.

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Chapter III.

PATHOLOGICAL ANATOMY OF BULLET WOUNDS AND DAMAGES OF SPINE AND SPINAL CORD.

Candidate of Medical sciences Lieutenant Colonel medical of service  
Ye. A. Uspenskiy.

The first investigations in the region of the pathological anatomy of the wounds of spine belong to N. I. Pirogov and they were produced by it during the Crimean war. Some of its positions/situations about the jolt of spinal cord did not lose value and up to now.

In 1913 V. L. Pokotilo it published the description of the first histological examinations of the wounds of spinal cord. But its data were based mainly on the single observations of bullet wounds and did not give the possibility to speak about any pathological-anatomical laws, noted with the wounds of spine as a whole.

The foreign authors with the pathoanatomical autopsies during the first world war produced the histological examinations of the bullet wounds of spinal cord. These investigations, with small exception, had as a goal mainly the study of the mechanism of the activity of the wounding shell and in essence characterized the pathoanatomical pictures only of fresh wounds.

After war with White Finns (1939-1940) and especially in the period of the Great Patriotic War and the postwar time in the Soviet literature appeared the works, considerably wider lighting different questions of pathogenesis and pathological anatomy of bullet wounds and damages of spine and spinal cord, and by the equal mode also of their complications (A. N. Bakulev, A. M. Wiechert, A. I. Geymanovich, V. V. Pishchugin, A. Ya. Podgorny, A. L. Polenov, I. Ya. Razdol'skiy, L. I. Smirnov et al.).

In spite of the intensified study of the wounds of spine and spinal cord, and also their different complications, in the literature yet it is not brought the necessary generalizations, and is also it is insufficiently given attention to the analysis of lethal outcomes and periods of the onset of death of the separate groups of the wounds of spine.

Meanwhile only the study of these problems taking into account the anatomical changes on different levels of localization of wounds in log of spinal column can give the most complete idea about entire diversity of the pathological processes, which appear during the bullet wounds and the damages to this region.

The frequency of the wounds of spine in the different periods of great Soviet war, established/installed on the autopsy, was the value of variable and, according to the data of the army and front line pathoanatomical laboratories (PAL), oscillated in the sufficiently large limits. Thus, on some armies the wounds of spine were from the tenths of percentage to 1.3, and on others these numerals were many times higher - from 3.8 to 6.00/o.

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For the explanation of such, comparatively large oscillations in the percent ratio on the independent armies and fronts it is possible to express two assumptions. First, a number of wounds into the spine could depend on the character/nature of combat operations/processes, in the second place, for different PAL a number of autopsies of dead persons from the wounds of spine it was not always identical and it



did not accurately reflect the actual relative frequency of these wounds.

According to the data the developments of the maps/charts/cards of autopsies, were considered both the isolated/insulated wounds of spine and wound of spine in combination with the wound of other areas: spine and breast, spine and stomach, spine and pelvis. In the army area the relative number of dead persons from these wounds among all dead persons composed 2.7o/o (Yu. G. Gul'kevich), in the army area - 5.1o/o (R. D. Stern), in the front line area - 7.6o/o (A. P. Avtsyn). On the basis of the given numerals it is possible to make the conclusion that the specific gravity/weight of dead persons from the wounds of spine among all dead persons from the bullet wounds grew/rose in proportion to removal/distance from the foremost stages of evacuation.

Bullet wounds and damages of spine, according to the developed protocols of autopsies, were distributed according to the character/nature of wounds as follows (Fig. 6).

The high percentage of nonpenetrating wounds, according to represented data, is explained by the fact that for the thorough study of different means of wounds and damages of spine are used all protocols, in which there were any indications of the wound of spine,

although lethal could be the wound and any other regions of body; whereas the bullet wounds of spine in this group it was possible to examine only as the associated wound. In connection with this during the establishment of the specific gravity/weight of different reasons for lethal outcomes the group of dead persons from the nonpenetrating wounds was not considered. Among the wounds of spine, which were basic, a quantity of nonpenetrating wounds was insignificant. Corresponding data are given in the general/common/total characteristic of pathoanatomical changes.

The penetrating wounds of spine were through, blind or tangential. Furthermore, they were divided into those isolated/insulated, i.e., without the wound of adjacent organs/controls, and combined - during the simultaneous damage/defeat by the wounding shell of the adjacent units or areas of body.

The combined wounds of spine were encountered in dead persons in the hospitals, according to the data of autopsies, are almost two times more frequently than those isolated/insulated.

The especially high frequency of the combined wounds is established/installed with the autopsies of those killed on the field of battle where the isolated/insulated wounds of spine composed 1.60/o, and those combined - 6.80/o (1:4, V. L. Byalik). The presence

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of the combined wounds acquired particularly important value from the point of view of the genesis of lethal outcomes.

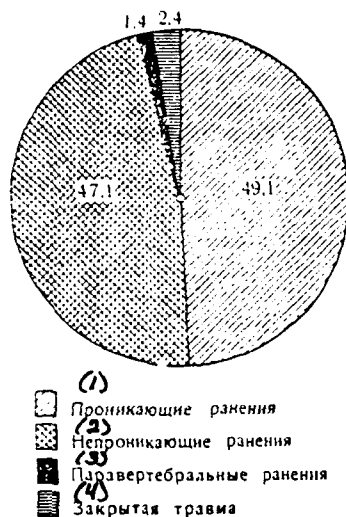


Fig. 6.

Key: (1). Penetrating wounds. (2). Nonpenetrating wounds. (3). Paravertebral wounds. (4). Closed trauma.

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On the basis of the analysis of data of autopsies it is established/installed, that in the predominant majority of the cases those wounded the spine perished not from the damages of spinal cord, but from the simultaneous wound of other vital organs/controls and from the complications, connected with the wound of these organs/controls.

Frequency of the combined wounds of spine and other regions of body (in the relative numbers to entire quantity of studied protocols of autopsies).

(1) Ранения позвоночника и мягких тканей головы .	0,8
(2) Ранения позвоночника и лица—череп с повреждением костей . . . . .	1,9
(3) Ранения позвоночника с повреждением черепа и головного мозга . . . . .	0,2
(4) Ранения позвоночника и органов шеи . . . . .	4,3
(5) Ранения позвоночника и шеи—груди с повреждением органов . . . . .	0,8
(6) Ранения позвоночника с повреждением грудной клетки и ее внутренних органов . . . . .	15,6
(7) Ранения позвоночника и груди—живота с повреждением внутренних органов . . . . .	2,8
(8) Ранения позвоночника и ранения живота с повреждением внутренних органов . . . . .	11,9
(9) Ранения позвоночника и ранения костей и органов таза . . . . .	8,6
(10) Ранения позвоночника и ранения брюшинных органов . . . . .	7,7
(11) Ранения позвоночника и ранения туловища и конечностей . . . . .	15,4

(12) Итого . . . . . 100,0

Key: (1). Wounds of spine and soft tissues of head. (2). Wounds of spine and face - skull by damage of bones. (3). Wounds of spine with damage of skull and brain. (4). Wounds of spine and organs/controls of neck. (5). Wounds of spine and neck - breast with damage of organs/controls. (6). Wounds of spine with damage of chest and its internal organs/controls. (7). Wounds of spine and breast - stomach with damage of internal organs/controls. (8). Wounds of spine and wound of stomach with damage of internal organs/controls. (9). Wounds of spine and wound of bones and organs/controls of pelvis. (10). Wounds of spine and wound of retroperitoneal organs/controls. (11). Wounds of spine and wound of body and extremities. (12). Altogether.

Thus, most frequently in dead persons from the wounds of spine these damages were combined with the wound of chest, in the second place stood the combinations with the wound of body and extremities, on the third - with the wound of stomach.

The nonpenetrating wounds of spine, as it was already shown, in the clinical X-ray classification were characterized by the damage only of extensions and bodies of vertebrae without the autopsy of the walls of spinal canal. However, even with of this type the wounds of spine in the separate protocols was given the description of considerable hemorrhaging into the shells and the substance of the spinal cord, and also the extensive foci of its softening, that were being escorted/tracked by severe complications.

The paravertebral wounds, which are characterized with the integrity of spine by presence in the spinal cord of morphological changes in the contusion character/nature, were encountered very rarely.

The relationships/ratios of the frequency of the wounds of the anatomical divisions of spine, noted with the autopsies on the field of battle and in the stages of evacuation, are different. On the field of battle the wounds of neck division were observed into 31.00/o of, those of thoracic division - into 43.20/o, lumbar - into

20.7o/o, sacral - into 2.1o/o. The multiple wounds of spine there were 3.0o/o (V. L. Byalik). In the stages of evacuation the distribution of a number of wounds according to the levels was somewhat different. Thus, the wounds of neck division are noted into 11.7o/o of, those of thoracic division - into 53.2o/o, lumbar - into 26.7o/o, sacral - into 6.3o/o. The multiple wounds of spine were observed into 2.1o/o.

From the comparisons of these data it is evident that the great relative number of wounds of neck division noted among the dead persons from the wounds of spine on the field of battle, while the wounds of other divisions predominated in dead persons in different stages of evacuation.

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Close to these numerals given, given in the reports on the separate combat operations/processes. Thus, for instance, with the taking of Berlin, on reports of one of the fronts, among the dead persons of the wound of the neck division of spine they composed 10.0o/o, thoracic - 55.0o/o, lumbar- sacral - 35.0o/o.

L. I. Smirnov, who produced autopsies in the hospitals of front rear, gives percentage relationships/ratios of the frequency of the

wounds of spine on the levels which confirm the noted above law. According to his data, the wounds of neck division composed 6.0o/o, thoracic - 56.0o/o, lumbar - 29.0o/o and sacral - 9.0o/o.

Thus, a great number of wounds of the neck division of spine among the dead persons was encountered on the field of battle. Doubly thinner/less frequent this localization was observed among the dead persons in the front line hospitals. However, the relative frequency of the wounds of thoracic and lumbar- sacral division, established/installed in dead persons, grew/rose in proportion to removal/distance from the foremost stages of evacuation.

Some questions of the mechanism of bullet wounds and damages of spine and its contents.

Intensity, diversity and form of fracture of spine and spinal cord depended: 1) on form/species, size/dimension and manpower of the wounding shell (bullet, fragment, etc.), 2) from the angle of touching of the wounding shell with the surface of spine even 3) from the anatomical special feature/peculiarity of the damaged division of spine.

Among the dead persons from the bullet wounds of spine noticeably predominated the obtained fragmentation wounds (Fig. 7).



Together with the large/coarse fragments, the reason for the heavy destruction of spinal cord frequently were the smallest fragments of the HE shells whose manpower two times exceeds the force of rifle bullet (P. A. Cyprians).

The severity of the wound of spine and spinal cord depended on the angle of touching or the wounding shell with the spine. The greatest destruction along of spinal cord appeared when bullet or fragment of shell struck at sharp angle to spine and gave the tangential "slipping" wound. During the analysis of the character/nature of the wounds of spine and contained spinal canal it is necessary to consider the anatomical and functional special features/peculiarities of this region.

1. Severity of consequences of bullet wound of spine is determined not so much by damage to bone unit, as by violation of integrity of substance of spinal cord or by its implication in one or the other complication.

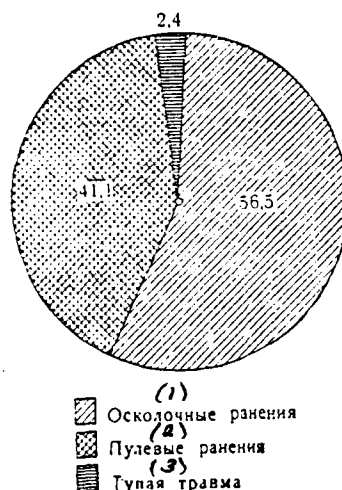


Fig. 7. Distribution of the wounds of spine according to the type of the wounding weapon among the dead persons.

Key: (1). Fragmentation wounds. (2). Bullet wounds. (3). Dull trauma.

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2. Pathoanatomical changes appear in spinal cord not only as a result of direct activity of bullet wound, but also as a result of transmission of manpower with wounds of adjacent regions (edges/fins, collar bone, spatula, pelvic bones or large/coarse nerve trunks, plexes/plexi and rootlets of horse tail out of spine). This is partly explained by the fact that the spinal cord is sufficiently tightly

fixed/recorded on spine spinal rootlets and serrated ligaments.

3. Cerebro-spinal fluid in spinal canal with sharp/acute pressure increase under activity of combat shell can deposit on spinal cord considerable additional damages.

4. Relatively small diameter of spinal cord, which is located in narrow closed bone area, contributes to development of different form/species of its supplementary trauma (liquor jerk/impulse, jolt, secondary shells).

In the opinion of a number of the authors (I. Ya. Razdol'skiy et al.), in the period of the Great Patriotic War into 50.00/o of wounds of spine the spinal cord was damaged directly by bullet or metallic fragments, whereas in the remaining unit of the cases acted the additional mechanisms of wound (liquor jerk/impulse, bone fragments, jolt, etc.).

Basic focus in the spinal cord, as a rule, appears at the level of the damaged vertebra, but sometimes the main focus of destruction in the substance of brain was arranged/located above or lower than the wound zone in the spine. Moreover, in the protocols of autopsies and in the literature it was indicated presence of two and even three foci of the destruction of spinal cord with one wound of spine (A. A.

Kulikovskaya, L. I. Smirnov).

This position/situation finds confirmation in I. V. Davydovskiy's opinion about the mechanism of the wound of different tissues. It just as many other authors, attaches much importance to the secondary shells among which the first place occupy bone fragments. For the explanation of the onset of the foci of damages in the distance from the basic wound they proposed hypothesis about the transmission (translation) of manpower in the side direction of the liquid composite/compound component part of the organ/control to the specific damping point/post.

Consequently, the greatest transmission of life force in the side direction occurs in the spine along extent of spinal cord. First of all this shock affected vascular net/system, as a result of which appeared relatively stable circulatory disorders at the more or less considerable distance from the basic focus.

In connection with the vascular disorders indicated in the substance of spinal cord subsequently were created the conditions for the development of ischemic foci and hemorrhage of different intensity.

In the onset of the isolated/insulated distant necrotic foci in

the spinal cord, together with the described hemo- liquorodynamic violations, with the penetrating wounds played considerable role the fine/small bone fragments which impeded the success of surgical intervention.

The x-ray examination of the preparations of spinal cord, produced in the pathoanatomical division of the military medical museum of the Ministry of the Armed forces of the USSR, showed that the smallest bone particles penetrated the substance of spinal cord at a distance of 10-13 cm from the basic wound.

Thus, in the practical sense everything indicated above gave the basis to consider that in the mechanism of the wounds of spinal cord, besides the wounding shell, high value had the supplementary traumatizing factors.

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Among these factors the leading place occupied bone fragments, then liquorodynamic violations, and also violations of vascular-reflector mechanism as a result of which appeared different in the volume necrobiotic foci, which were being frequently spread on entire diameter of spinal cord and to the distance of several centimeters on along length.

Reasons for death of those wounded a spine.

In different stages evacuation 25.20/o of casualties died as a result of the direct activity of bullet wound (destruction of organs/controls, shock, blood loss and shock, hemorrhage, acute edema of brain), and into 74.80/o death it followed from the complications of infectious character/nature.

From a number of studied protocols of the autopsies of dead persons from the wounds of spine it fell to army area 6.10/o, to the army - 48.10/o and on the front line - 43.40/o. The remaining 2.40/o of lethal outcomes fell on the closed damages of spine, which were being observed predominantly in the front line area. Consequently, a great number of observations, which entered in this chapter, falls on the army and front line area where, as is known, within entire period of the Great Patriotic War was produced a great number of autopsies. On the evacuation routes in essence died the obtained heavy combined wounds.

In the examination of lethal outcomes from the complications, which followed on the evacuation routes into the front rear, it turned out that the half dead persons had suppurative complications

from the side of chest, predominantly fibrinogenous-suppurative pleurisy, wound pneumonia, including contralateral, to a considerable extent aggravated the condition wounded in the spine and led them to death.

As the reasons for death as a result of the direct activity of bullet wound with the isolated/insulated wounds of spine in the first place came forward the extensive destruction of spinal cord.

The reasons for death with the isolated/insulated wounds at different levels of spine were the following: with the wound of neck division into 69.50/o was observed the destruction of spinal cord, also, into 30.50/o - acute edema of shells and substance of brain; with the wound of upper thoracic division into 80.00/o lethal outcome it attacked/advanced from the destruction of spinal cord and into 20.00/o - from ascending edema of shells and substance of brain; with the wound of average/mean thoracic division death attacked/advanced from the destruction of spinal cord into 75.00/o and into 25.00/o - from the blood loss; the wound of lower thoracic division in all cases (100.00/o) led to the lethal outcome from the destruction of spinal cord, with the wounds of lumbar division 81.80/o of lethal outcomes were caused by the destruction of brain and 18.20/o - by blood loss; the wounds of sacral region in all cases (100.00/o) ended by death from the blood loss. The latter is explained by the fact

that with the extensive wounds of this unit of the spine, as the damages of spine into 66.70/o death it attacked/advanced from the destruction of brain and into 33.30/o - from the blood loss; the relatively high percentage of death from the blood loss with the multiple wounds it was conditioned on a comparatively frequent wound of spinal and interfin arteries.

Other completely picture presented data of the development of the protocols of autopsies with the combined wounds. Here as the reason for death in the first place stood shock, blood loss and their combination, while death from the destruction of brain, only with small exception, was encountered many times less frequent than with the isolated/insulated wounds.

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With the combined wounds of the discrete levels of the spine of the reason for death following: with the wound of neck division they died of the destruction of spinal cord 37.00/o, as a result of the destruction of other organs/controls - 2.90/o, from the shock - 20.00/o, from the blood loss - 8.60/o, from the shock and the blood loss - 2.90/o, from ascending edema of shells and substance of brain - 28.60/o; with the wound of upper thoracic division death depended on the destruction of spinal cord into 16.40/o of cases, from the



destruction of other organs/controls - into 7.30/o, from the shock - into 22.50/o, from blood loss - into 37.40/o, from the shock and the blood loss - into 7.30/o,

and from ascending edema of shells and substance of brain - into 9.10/o; with the wound of average/mean thoracic division death from the destruction of spinal cord advanced 7.50/o of cases, from the destruction of other organs/controls - into 5.00/o, from the shock - into 22.50/o, from the blood loss - into 42.50/o, from the shock and the blood loss - into 22.50/o; the wounds of lower thoracic division led to the lethal outcome from the destruction of spinal cord into 8.30/o, from the destruction of other organs/controls - into 11.10/o, from the shock - into 25.00/o, from the blood loss into 30.60/o, from the shock and the blood loss - into 25.00/o; with the wound of lumbar division death followed into 4.50/o of the destruction of spinal cord, into 9.10/o of the destruction of other organs/controls, into 31.80/o - from the shock, into 31.90/o - from the blood loss, into 22.70/o - from the combination of shock and blood loss; 55.60/o wounded the sacral division of spine with the combined wounds died of the shock, 11.10/o - from the blood loss and 33.30/o - from the shock and the blood loss.

The very demonstrative characteristic of lethal outcomes is given in the summary tables, which make it possible to compare the

value of different complications and severity of wound itself as the reasons for death with different in the character/nature and the level wounds of spine.

From Table 8 it is evident that with the isolated/insulated penetrating wounds of the neck division of spine most frequently (61.60/o) death attacked/advanced from the direct activity of bullet wound. Comparatively in the small percentage of the cases with this localization the reason for death was urosepsis (11.5), are still less Frequent suppurative processes in the shells and the substance of spinal cord (3.8).

Table 8. Reasons for death with the penetrating isolated/insulated bullet wounds of spine (on the discrete levels of damage) (in the percentages).

(1) Уровень повреждения позвоночника	(2) Прямая активность ранения	(3) Менингит	(4) Менингитомиелиз	(5) Уросепсис	(6) Септикопиемия	(7) Гнойный процесс в грудной клетке	(8) Столбняк	(9) Анаэробная инфекция	(10) Пневмония	(11) Итого
(12) Шейный отдел	61,6	3,8	3,8	11,5	19,3	—	—	—	—	100,0
(13) Верхний грудной отдел	22,5	—	—	8,8	21,3	—	—	31,6	15,8	100,0
(14) Средний грудной отдел	4,5	2,6	—	17,2	23,7	—	2,6	10,5	8,9	100,0
(15) Нижний грудной отдел	1,9	16,3	2,0	26,7	12,9	—	—	5,1	6,1	100,0
(16) Поясничной отдел	10,4	22,0	1,3	26,0	26,0	1,3	2,6	6,5	3,9	100,0
(17) Крестцовый отдел	9,1	9,1	—	25,3	38,3	—	—	18,2	—	100,0
(18) Множественные ранения	59,0	—	—	—	25,0	—	—	25,0	—	100,0
(11) Итого	16,0	11,8	1,3	26,6	30,0	0,4	1,3	6,3	6,3	100,0

Key: (1). Level of the damage of spine. (2). Direct activity of wound. (3). Meningitis. (4). Meningomyelitis. (5). Urosepsis. (6). Septicopyemia. (7). Suppuration in chest. (8). Tetanus. (9). Anaerobic infection. (10). Pneumonia. (11). Altogether. (12). Entire division. (13). Upper thoracic division. (14). Average/mean thoracic division. (15). Lower thoracic division. (16). Lumbar division. (17). Sacral division. (18). Multiple to wound.

For the penetrating wounds of the thoracic division of spine is

characteristic the decrease of a number of cases of death as a result of the direct activity of the trauma: 22.50/o - with the wounds of upper thoracic division, 4.50/o - average/mean thoracic division and 1.90/o - with the wounds of the lower thoracic division of spine. These dead death from the wounds of the lower thoracic division of spine, almost as a rule, it attacked/advanced from the shock and the blood loss.

The lower on length of spine was localized the wound, the less frequent in the dead persons of this group was encountered pneumonia as the reason for death (10.80/o in dead persons in the presence of wounds of upper thoracic, by 7.90/o average/mean thoracic and 6.10/o lower thoracic division) and the more frequent the reason for death were connected with sepsis - 42.90/o and urosepsis - 47.00/o.

The frequency of suppurative processes in the shells as the reason for death, on the contrary, was raised in proportion to a decrease in the level of wound from the upper to the lower thoracic division (from 2.6 to 16.30/o).

Is especially great the value of suppurative processes in the shells as the reason for death in dead persons from the wound of the lumbar division of spine and at the level of horse tail, which coincided with the clinical observations of the authors in the Great

Patriotic War.

In the analyzed group (Table 9), just as with the isolated/insulated penetrating wounds, the greatest specific gravity/weight with the wounds at all levels of spine had death from the direct activity of bullet wound.

Table 9. Reasons for death with the combined wounds of spine (on the discrete levels of damage) (in the percentages).

(1) Уровень повреждения позвоночника	(2) Непосредственное действие ранения	(3) Менингит	(4) Менингонизит	(5) Уrosepsis	(6) Септикопиемия	(7) Гнойный процесс в грудной клетке	(8) Перитонит	(9) Столбняк	(10) Анаэробная инфекция	(11) Пневмония	(12) Итого
(13) Шейный отдел	55,3	5,6	—	11,1	22,2	—	—	—	—	5,6	100,0
(14) Верхний грудной отдел	42,3	5,1	—	22,0	10,2	6,8	—	1,7	3,4	8,5	100,0
(15) Средний грудной отдел	33,5	1,4	—	27,5	16,0	8,7	1,1	—	4,3	7,2	100,0
(16) Нижний грудной отдел	16,4	5,5	—	24,7	20,5	17,8	4,1	—	5,5	7,5	100,0
(17) Поясничной отдел	26,5	16,1	—	12,7	16,1	1,1	14,2	—	6,9	5,7	100,0
(18) Крестцовый отдел	28,0	28,0	—	12,0	20,0	—	8,0	—	4,0	—	100,0
(19) Множественные ранения	—	—	—	—	—	—	—	—	—	—	100,0
(12) Итого	30,2	9,1	—	20,0	16,6	7,3	5,7	0,3	4,8	6,0	100,0

Key: (1). Level of the damage of spine. (2). Direct activity of wound. (3). Meningitis. (4). Meningomyelitis (5). Urosepsis. (6). Septicopyemia. (7). Suppuration in chest. (8). Peritonitis. (9). Tetanus. (10). Anaerobic infection. (11). Pneumonia. (12). Altogether. (13). Neck division. (14). Upper thoracic division. (15). Average/mean thoracic division. (16). Lower thoracic division. (17). Lumbar division. (18). Sacral division. (19). Multiple wounds.

In this group just as with the isolated/insulated wounds, grew/rose a

number of lethal outcomes from meningitis with the wounds of the lumbar and sacral division of spine; relatively high numerals fell on urosepsis with the wound of thoracic, and also lumbar division. The reason for death was also peritonitis, which acquires the particularly important value with the combined wounds of the lumbar division of spine and organs/controls of abdominal area. Finally, was here raised also a number of the fatal results from the suppurative processes in the chest with the bullet wounds of the thoracic division of spine.

Periods of the onset of death from the complications in those wounded the spine.

On the basis of statistical data, that characterize the periods of the onset of death from the complications in those wounded into the spine, it is possible to establish/install the series/number of laws of the relation to the duration life of casualties from the moment/torque of wound. These laws especially convincingly come forward in the cases of death from suppurative meningitis, urosepsis, sepsis and pneumonia. Thus, a great number of casualties perished from suppurative meningitis (32.00/o) on the 10-20th day and on 20-30th day (29.30/o) after wound. Death attacked/advanced for a period of the first 3-5 days into 9.30/o of cases, from 5 to 10 days - into 21.00/o, from 1 to 3 months - into 7.60/o, and later than this

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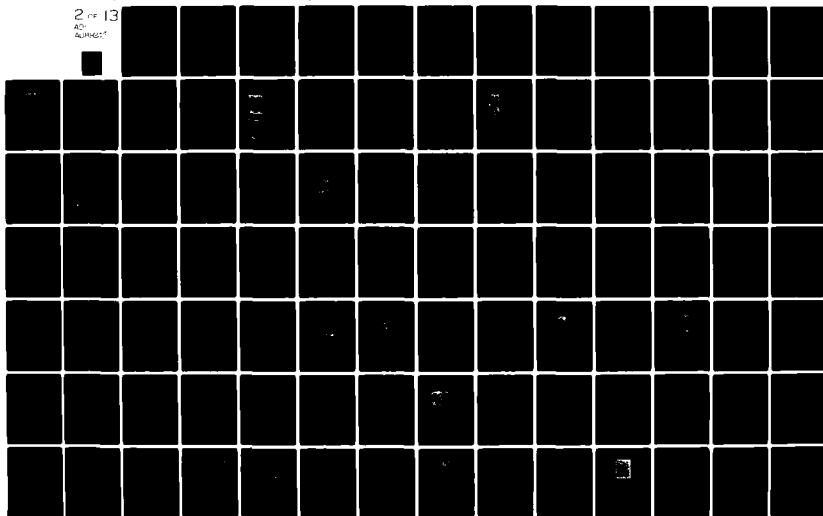
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period - into 0.80/o.

As can be seen from Fig. 8, the greatest percentage of the lethal outcomes, caused by sepsis and urcsepsis, fell on the 11-20th day after wound; this relative number was held on the high numerals to 3 months.

The variations of the frequency of lethal outcomes on the periods from the moment/torque of wound are observed also in the group of dead persons from pneumonia (by predominantly catarrhal), which is evident in Fig. 9.

Given data show that a great number of lethal outcomes among the dead persons from pneumonia advanced during the first 10 days; after this period the percentage of lethal outcomes from pneumonia gradually descends and reaches to 1.3 to 3 months after wound.

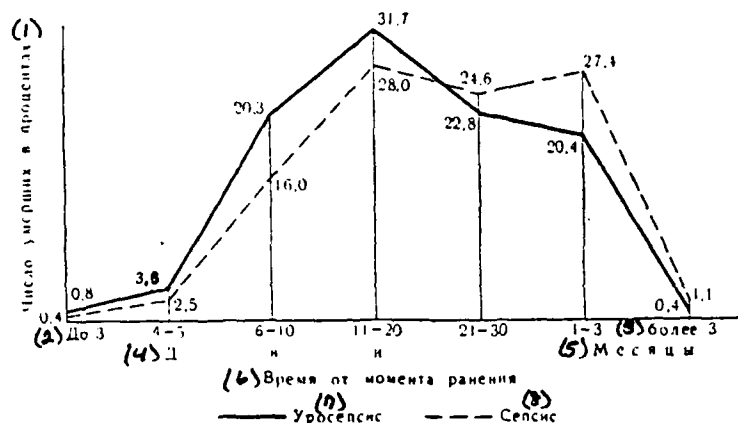


Fig. 8. Periods of lethal outcomes from sepsis and urosepsis with the wounds of spine and spinal cord.

Key: (1). Number of those who died, percent. (2). To. (3). it is more. (4). Dynes. (5). Months. (6). Urosepsis. (7). Sepsis.

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If the frequency of pneumonia during the first days after wound, established/installed on the autopsy, can be explained by the disorder of the coordination of respiration, by violation of intermotor innervation, etc., then within late periods of one of the reasons for the onset of pneumonia was lowered/reduced resistance of organism with the growing on depletion of those wounded the spine. Were here discovered predominantly catarrhal pneumonia, frequently on

the soil of the disorder of blood circulation (hypo-static type), i.e., pneumonia which usually were observed in heavy low-mobility casualties, forced long time to remain in the bed.

Diffuse meningomyelitis and tetanus in the insignificant percentage of the cases were only reason deaths of those wounded the spine. Most of all of those wounded the spine died of these complications during the first 10 days from the moment/torque of wound.

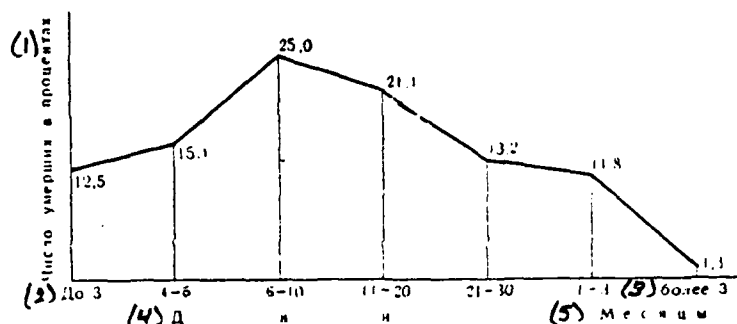


Fig. 9. Periods of lethal outcomes from pneumonia in those wounded the spine and the spinal cord.

Key: (1). Number deaths in the percentages. (2). To. (3). it is more. (4). Days. (5). Months.

Characteristic of pathoanatomical changes with the bullet wounds of spine and spinal cord.

On the basis of the experiment/experience of the Great Patriotic War in the development of the basic pathoanatomical and histopathological changes, which appear with the wound of spine and spinal cord, it is possible to tentatively secrete 4 periods, gradually converting one in another. In each of these periods are inherent not only pathomorphological, but also clinical special features/peculiarities.

Periods these following: sharp/acute, early, intermediate, late.

Sharp/acute period covers time from the moment/torque of wound for a period of the first three days. This period is characterized by different pictures of necrosis, which appeared both as a result of the direct straight/direct or lateral effect of the wounding shell on the spinal cord and its rootlets and as a result of the sharply developing disorders of root, liquor and lymph circulation, which led to the development of acute edema of the substance of brain. On the high levels of the wounds of spine and spinal cord edema, as it was already shown, was the basic reason for lethal outcome. The special position in the sharp/acute period occupies a necrosis of the type of Wallerian regeneration which can be revealed/detected already at the end of the first day both in that ascending and in the descending conducting systems of brain.

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For the duration of sharp/acute period changes in the necrotic character/nature can appear also in other organs/controls as, for example, in the urinary system in connection with the violation of the trophic function of damaged spinal cord. This type of complications, as noted in the analysis of lethal outcomes, can be the reason of death of casualty already to the third day.

Early period covers the subsequent 2-3 weeks. For it are characteristic the processes of organizing the foci of the damage of brain and the reverse development of reactive changes (edema of brain, the disorders of circulation, cerebrospinal shock). For the duration of this period those wounded into the spine are located under the threat of the development of very severe complications, which proceed both from wound itself and as a result of the emergent trophic violations. From the infectious complications for it are characteristic especially sharply elapsing meningitides, anaerobic infection, tetanus, external suppurative pachymeningitis. In this period achieve their maximum frequency septic complications (urosepsis, sepsis), pneumonia. During the favorable course of wound process toward the end this period can develop nonpurulent inflammatory changes in the soft cerebral shells in the form of the restricted adhesive or cystic arachnoiditis. Actively occurs the biological cleansing of wound; fine/small bone fragments undergo resorption. Around the large/coarse bone fragments, and also not removed from the spinal canal and the substances of the brain of foreign metallic bodies begins to be developed fibrous tissue. In the destroyed unit of the substance of spinal cord appears the reactive growth of fibroblastic and argyrophil tissue. In the first half the early period achieves full/total/complete development the process of

the Wallerian regeneration of the damaged conducting systems.

Intermediate period. Its duration about 3 months. In the relation to infectious complications the intermediate period is the direct continuation of the preceding period. The frequency of suppurative complications for entire its elongation/extent to 3 months inclusively still is held at the large height. In this period usually is finished the process of the cleansing of the wound of spinal cord; it is finished the organization of restricted, productive arachnoidites and cysts, and also cicatrical growths in the epidural tissues after pachymeningitis, in the series/number of cases heal the bedsores. For the duration of the intermediate period (it is more frequent than the second half) usually are developed complications in the bone unit of the spine, so-called wound osteomyelitis. The latter again create threat for life of victim since they are (true, comparatively rarely) focus for the complications as from the side of the soft shells (it is more frequent than the lymphogenic drift of infection), so also the septic disease.

The complications indicated can appear and much later, precisely for the duration of the late period whose beginning is counted from the 3rd month after wound. Period this continues up to 2-3 years and more. On the spot of the contusions of spinal cord usually come

forward the already well formed residual areas of the type of cysts. Scar tissue undergoes coarsening but resorptive process around it can be continued still sometimes during the decade. In connection with this in effect residual phenomena remain stable, but they can suddenly be peaked under the effect of the accidental infections.

Wounds of soft tissues.

Form/species and size/dimension of the fresh wounds of the soft tissues of back with the bullet wounds of the region of spinal column did not present any special features/peculiarities in comparison with the wounds of other regions of body.

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The diameter of inlets with the fine/small fragmentation wounds is small - to 0.2 cm inclusively, but with the bullet wounds usually it did not exceed 0.5-1 cm.

The most extensive decomposition of soft tissues was most frequently caused by the tangential fragmentation wounds with which, depending on the sizes/dimensions of fragments, frequently achieved the significant magnitude (10-15 cm and more).



Wound apertures were arranged/located at different levels directly above the posterior semiring of spinal column, and also far from it, in the walls of thoracic and abdominal area. The direction of wound canals was very diverse - either at the right angle to the spine or downward or from bottom to top. It was difficult to determine the direction of wound canals with the blind-end wounds when inlet was arranged/located far from the spine, for example, in the region of shoulder or hip joint, and sometimes also the extremital units of the extremities. Similar wound canals, predominantly bullet, frequently went along the broken line.

In one of the observations of A. A. Kulikovskoy the bullet, after damaging bodies of the VI and VII thoracic vertebra (inlet), opened diaphragm/midriff, the liver and, after being hit against the wing of right iliac bone, by ricochet bounced upwards and it jammed in the gasket at the level of caecum. In other given it observation wound canal passed through the soft tissues of upper third of right shoulder, through the III edge/fin into the thoracic area to the right, along the posterior division of the lung, further through the spinal canal at the level of the XII thoracic and I lumbar vertebra and to the right along the rootlets of horse tail; bullet was discovered on the day of the sack of solid cerebral shell. In the protocols of autopsy was given the description of the wound canals (inlet of which was arranged/located far from the spine), which

passed through the thoracic and abdominal area and finished either as the open outlet near the spine, or blindly in the spinal canal without the decomposition of skin integuments.

In the fresh wounds and input, and outlet they frequently proved to be dry and gaping, sometimes they were filled with blood roll, and sometimes from the wound escape/ensued blood-containing fluid/liquid.

It is known that the unit of the bullet and small-splintered wounds of soft tissues, even upon the heavy decomposition of spinal cord, healed by primary tension. However, with the secondary tension very frequently the process of the cleansing of wounds (rejection/separation of necrotic masses) was involved/tightened, since the general/common/total resistivity of organism was lowered/reduced in connection with the presence of the exhausting complications (bedsores, uroinfection, pneumonia, etc.). This type of tightening themselves processes of the cleansing of wounds especially frequently were observed with the combined wounds of thoracic and lumbar region. Around the external wound in such cases frequently was developed the phlegmon.

In the genesis of some early developing severe infectious complications had a value the character/nature of causative agent and its virulence. A number of these complications included early

meningitides, which are finished with death to the 3-5th day after wound, tetanus and anaerobic gangrene.

The study of the protocols of autopsies made it possible to establish/install different conditions of external wound and development of the suppurative complications, which appeared within the spinal canal. The given in the protocols pathoanatomical changes it made possible to secrete the following groups of the wound complications, differing by mechanisms and by periods of their onset.

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In the first place in the frequency will cost the so-called "festering of wound canal". This diagnosis usually characterized the suppuration of wound canal, which covers external wound, solid and soft shell and substance of spinal cord. However, this type of complications were most frequently finished with lethal outcomes during the first 10-15 days after wound. The second group composed suppurative complications in the soft cerebral shells when the phlegmon of external wound is present,. With this form/species complications lethal outcomes attacked/advanced 1 1/2 months after wound. In the third group of wounds external wound was represented by that healed, by frequently primary tension; within the spinal canal was discovered external pachymeningitis and suppurative

meningomyelitis. These complications were the reason for death in the period from 1-2 months to 6-8 months, and sometimes also to the year inclusively after wound. Finally, four-group composed the suppurative complications, which were being developed in the substance of spinal cord and its shells and those caused by osteomyelitic processes in the bones of spine in the presence of the closed external wound. This were the late complications, which were developed in the period from 2 months to 1-2 years and more after wound.

Thus, according given data, the development of suppurative complications within the spinal canal hardly ever was connected with the suppuration in the external wound. Hence it is possible to make the conclusion that in the mechanism of the development mainly of late suppurative complications the vital importance had not only the shielding function of macroorganism as a whole, but also the local conditions, which affect the development of inflammatory changes, somehow: the delay of the rejection/separation of necrotic masses or the presence of foreign bodies in the wound of spinal canal.



Fig. 10. Blind-end fragmentation wound of bodies of the V and VII thoracic vertebra. Preparation VMM No 2017.

Wounds of the bone units of the spine.

The character/nature of the wound of the bones of spine is not identical. As is known, the bodies of vertebrae, with exception the first two neck ones, consist of porous tissue and it is only on the surface covered with the sufficiently thin layer of compact bone plate. By this structural special feature/peculiarity of the bodies of vertebrae it is explained, why in those pierced by bullet the bodies of vertebrae, as a rule, there was not fine fragments, but most frequently was formed well expressed by wound canal. Less

frequent from the bodies of vertebrae with the bullet wounds were broken off sufficiently large/coarse plates (Fig. 10).

In contrast to this upon the decomposition of small arcs and extensions, which consist in essence of the compact plate and only of the insignificant unit of the porous substance, as a rule, appeared the crushed multi-fragmented breaks.

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With the wounds of rump frequently were observed not only the damages of the standing crests/peaks, especially average/mean, but also the considerable decomposition of the posterior wall of rump (Fig. 11), decomposition of both walls (Fig. 12), or the full/total/complete breaks and decomposition in the region of iliac-sacral articulation.

With the passage of the wounding shell on the horizontal plane in posterior-front or side direction to the spine predominated various kinds the breaking up of posterior semiring - from the insignificant splitting of bone plates to the complete destruction of small arcs, cross and awned extensions, and also joint surfaces.

The breaking up of the bodies of vertebrae was observed predominantly during the equalizations by comparatively large fragments. However, the extensive bullet damages of the bodies of vertebrae were noted only under the disruptive effect of bullet, i.e., with the shots from the close distance.

In flight of bullet or fragment of shell in the oblique or vertical to the axis of spine direction were frequently affected several series/number of the arranged/located vertebrae.

We give the protocol of autopsy.

L-is wounded by bullet 28/VII 1944, he died during the same day. Pathoanatomical diagnosis: the perforating combined wound of chest and spine with the small-splintered break of small arc of IX thoracic vertebra, the decomposition of bodies of their VIII IX thoracic vertebra and break of the II edge/fin to the left. The full/total/complete interruption of spinal cord (prosector - captain of medical service A. Kcmkov).





Fig. 11. Bullet perforated break of the left half of sacrum.

Preparation VMM No 962.



Fig. 12. Bullet tangential wound of posterior wall of rump to the

left. Preparation VMM No 2284.

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Preparation No 3868. Sagittal cut of the thoracic unit of the spine (spinal cord together with the solid cerebral shell is removed). Wound canal passes through the soft tissues of back, bone of the posterior semiring of spinal column, the spinal canal and the bodies of the destroyed VIII and IX thoracic vertebrae. At the spinal canal bone fragments and massive blood clots, which lie at the epidural space above and below from the wounded canal (Fig. 13).

The dead persons as a result of the wound of spine most frequently had the damages of posterior semiring (70.80/o), the damages of the bodies of vertebrae were noted only into 15.60/o; other combinations of wounds were encountered considerably less frequent; so, the damages of extensions and bodies were in 6.10/o case, small arcs and bodies - into 3.60/o, the small arcs of, those the extensions and bodies - into 2.30/o; finally, the breaks of spine with the displacement of vertebrae were encountered into 1.60/o of cases.

According to the data of L. I. Smirnov, damage of small arcs and extensions they were observed on the autopsy into 62.00/o of cases;

the bodies of vertebrae - into 14.00/o; the damages of bodies and small arcs - 24.00/o. V. V. Pischugin cite data of the autopsies of the front line evacuation hospital, according to which the small arcs and extensions were damaged into 53.00/o of cases; the bodies of vertebrae - into 15.00/o of body and small arc into 32.00/o; the breaks of spine with the displacement of vertebrae to the sides composed 7.00/o.

Wounds of spinal cord and its shells.

According to data of the protocols of the autopsies of dead persons from the penetrating bullet wounds of spine, wound without the damage of solid cerebral shell they were encountered into 34.10/o, and with the damage of shell - into 65.90/o.

Is intravital the damage of solid cerebral shell, with exception of extensive wounds, it was established/installed only with surgical intervention or in the presence of liquorrhea, in the remaining cases of wound the shells remained unidentified. Based on this, clinicians in the practical sense completely correctly considered that for determining the penetrating wounds it suffices to establish/install the damages only of osteoligamentous apparatus of spine with the damage of the integrity of the walls of spinal canal.

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Foreign bodies and bone fragments with the blind-end penetrating wounds of spine, according to data of autopsies, were possessed in epidural space and under the internal leaflet of solid cerebral shell, after inflicting damage on to rootlets of spinal cord, or they were introduced in the substance of spinal cord.



Fig. 13. Perforating bullet wound of spine with decomposition the VIII and IX thoracic vertebra. Preparation VMM No 3868.

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The wounded defects of solid cerebral shell were very diverse in form and sizes/dimensions and they took the form of perforated defects with the uneven torn edges. Very frequently, predominantly with the wounds of sacrolumbar region, the sizes/dimensions of wound apertures in the solid cerebral shell many times exceeded the sizes/dimensions of the wounding shell (Fig. 14).

With the extensive spinal-cerebrospinal wounds, destroyed proved to be intersgmental apparatus (spinal roots, intervertebral ganglia/nodes and sympathetic frontier shafts or then rami communicantes). At the level of horse's tail frequently was noted the decomposition of a considerable number of root filaments or the complete destruction of this unit of spinal cord.

In the pathology of bullet wounds and damages of spine and spinal cord, together with the direct activity of trauma and infection, should be considered as leading disorder liquor- and blood circulations.

Acute reactive edema of the substance of spinal cord with the bullet wounds of spine - phenomenon constant. It was noted also during the operation/process, and during the experimental investigations (Z. I. Geymanovich and N. A. Zolotova). According to data of pathoanatomical autopsies, primary acute edema in those wounded the neck division of spine had the ascending character/nature and it was frequently the reason for death on the field of battle and during the first days after wound.

The pictures of the fresh wounds of spinal cord, discovered with

the autopsy of twigs/rods in the army area, in essence were reduced to the following.

With the perforating penetrating bullet or fragmentation wounds of spinal column with the full/total/complete or partial interruption of spinal cord were noted different degree of hemorrhage into the spinal canal with the diffuse impregnation of epidural cellulose by the blood, blood rolls on the external and internal surface of solid cerebral shell, sub-arachnoidal hemorrhages and hemorrhages into intervertebral ganglia/nodes.

Hemorrhages into the shells of spinal cord took the form of different value of the maculae which applied to considerable space upward and downward from the place of wound (Fig. 15 and 16).

Histological investigation showed that hemorrhage in membranes of the back of the vessels of very shells of epidural cellulose and bone veins, but also via diapedesis against the background of vascular stasis in shells themselves. Therefore even through several days after wound on the autopsy were encountered fresh tunical hemorrhages (Fig. 17). Together with the hemorrhagic phenomena in membranes, almost as a rule, was detected edema, which predominantly was spread on the slits of arachnoidal space and partly between the filaments of soft shell. Such an edema into some preparations was

local around the wound, in other preparations it was spread along the log of spinal cord at the considerable distance from the place of wound. Already during the first days after wound usually was noted the sharp expansion of the arachnoidal slits whose trabeculas just as the passing along them vessels, were infiltrated by the accumulations of histiocytic elements/cells. Thus, was a picture of reactive serous arachnoiditis (Fig. 18). In the solid cerebral shell edema was observed much more rarely, besides its only internal leaflet.

With the full/total/complete interruption of spinal cord its ends frequently proved to be softened, with the uneven fringed edges, or inflated, reddish color and were located from each other on 1-2, and sometimes also more than centimeters (Fig. 19 and 20).





Fig. 14. Perforating fragmentation penetrating wound at the level of II lumbar vertebra with perforated defect of solid cerebral shell, the damage of cone and roots of horse tail. Preparation VMM No 1051. (Artist of T. V. Belyayev).



Fig. 15. Blind-end fragmentation penetrating wound of the neck division of spine. On the posterior surface of the seventh and eighth neck segment the decomposition of the substance of spinal cord. In

the region of third-fifth thoracic segment the small surface foci of red softening. Between the rootlets to the right the rolls of the blood, which lie under the arachnoid shell. Injection of the vessels of solid and soft cerebral shell. Preparation VMM No 619. (Artist of T. V. Balyayev.).



Fig. 16. Perforating bullet wound of chest and spine at the level of VIII thoracic vertebra with the perforating wound of spinal cord. On the internal surface of solid cerebral shell on entire length are

arranged/located the thin lamellar impositions of blood clots of brown color. In the region of the tenth thoracic segment the substance of spinal cord destroyed takes the form of amorphous mass. With respect to this place is a wound defect 4x3 mm (inlet) in the solid cerebral shell (outlet from the ventral side). Preparation VMM No 1003. (Artist of T. V. Belyayev.).



Fig. 17. Blind-end fragmentation penetrating wound of the thoracic division of spine. Fresh submembrane hemorrhage. The vessels of solid

cerebral shell are expanded and filled with the blood. Preparation VMM No 2891. (Artist V. E. Busch.).

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According to the data of the autopsies of the twigs/rods of dead persons on the field of battle, the decomposition of spinal cord sometimes it achieved 15-16 cm.

Histotopographic study of preparations in the longitudinal shear/sections (on the length of spinal cord) made possible to note the series/number of essential data in the relation to the common picture of the wounds of spinal cord. Usually tail piece of the proximal division of the interrupted spinal cord was edematic, moreover frequently it swelled it was extended beyond the limits of the destroyed segment; about this testified the crimp of the fiber of the white substance of brain in the zone of edema. Above positions of fracture frequently were encountered irregular form the foci of the edge/boundary necroses of spinal cord. Such foci applied to the considerable distance from the place of interruption; during the histological investigation frequently in the necrotized mass detected fine/small bone fragments. Finally, far from the place of interruption in the brain tissue were noted the foci of hemorrhage (Fig. 21).



Fig. 18. Reactive arachnoiditis in the region of posterior rootlets of the thoracic division of spinal cord. Microphotogram. Preparation VMM No 148. Stain/staining with the hematoxilineosin. VOMP. Ocular 8, objective 10.





Fig. 19. Blind-end bullet wound of the left half chest and spine. The blunt-ended bullet of submachine gun will hit the ground between the stumps of completely smashed by it spinal cord. The ends of the

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stumps, more lower, are impregnated with the blood. In the solid cerebral shell large/carse perforated defect. Preparation VMM No 1005. (Artist V. S. Chumanova.).



Fig. 20. Blind-end fragmentation penetrating wound of the lumbar division of spine. Wound of the cone of spinal cord, full/total/complete interruption of horse tail. Preparation VMM No 755. (Artist of T. V. Belyayev.).

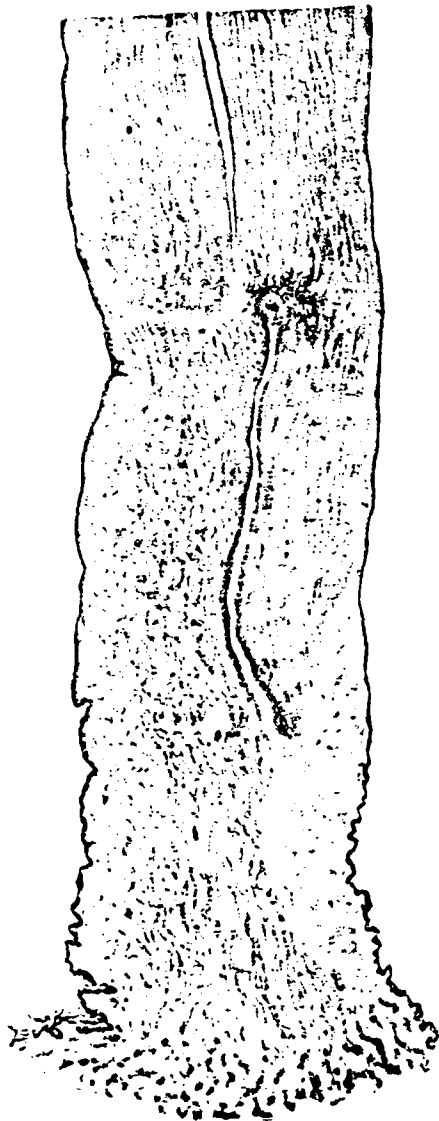


Fig. 21. Perforating bullet penetrating wound of spine at the level of IV thoracic vertebra with the full/total/complete interruption of spinal cord. Frontal shear/section through the front/leading columns.

Stump of the proximal cut of spinal cord. Edge/boundary necrosis (to the right), edema; the focus of hemorrhage in the distance from the wound. Preparation VMM No 673. (Artist V. E. Busch.).

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In the cross shear/sections were detected the hemorrhages in the white and gray substance, which were being spread usually for the elongation/extent of 2-3 segments above and below the level of wound (Fig. 22). Further, from this level hemorrhages were decreased, remaining primarily in the gray substance.

For the perforating and blind-end wounds of spinal cord is macroscopically characteristic peculiar tuberosity of the surface of wound. This change they appeared as a result of intra-medullary edema and hemorrhages. This was especially distinctly noticeably during the removal/distance of soft cerebral shell after brief fixation of preparation (Fig. 23). On the fresh preparations the edematous substance of brain was usually diluted; in this case it protruded above the surface of section/cut and spread.

The present central hematomyelia, according to the data of autopsies during the period of the Great Patriotic War, it was noted extremely rarely, being only one hundredths of a percent. This type

of hamatomyelia were described usually as the hemorrhages, which were being strictly localized in the region of front/leading joint and central canal, with extent into several segments of spinal cord.

In the extremital cut of the interrupted spinal cord, together with the described pictures of edema and hemorrhages, already from the 2-3rd day after wound in the filaments of motor and sensitive system was noted the initial stage of vallerovskiy regeneration.

In these periods on the preparations, processed by osmium acid on the marks, focused attention the intense decomposition/decay of myeline in the form of black lumps and spheres, arranged/located on the course of filaments.

However, cellular apparatus in the lying/horizontal below segments, on the contrary, remained invariable/unchanged. On a large number of preparations, painted according Nissl', it was possible to note that with the wounds of spinal cord the motor nerve cells of lower than the level of wound retained their normal structure. These data can serve as the morphological confirmation of the clinical observations of the reduction of reflexes of lower level of wound of spinal cord. Reflexes usually were reduced and they achieved the degree of pathological increase after the brief time after wound, as soon as disappeared the phenomena of the so-called spinal shock and

phenomenon of edema of spinal cord. Preserved lower than damage level motor cells in such cases proved to be capable of answering the stimulation.

With the nonpenetrating and penetrating wounds of spine without the damage of solid cerebral shell, and equally with the partial wound of spinal cord the foci of contusion softening were also fairly often escorted/tracked by edema and hemorrhages both in the substance of spinal cord and in the sub-arachnoidal space. The examination of the preparations of spinal cord (in the longitudinal sections) showed that the softening sometimes occupied the sufficiently significant part of length of brain (Fig. 24 and 25). This extensive softening, apparently was connected with the decomposition of the shafts of front/leading or posterior spinal artery.

A. Ya. Podgorny gives a series/number of the cases, in which the foci of softening were area with many cracks, frequently occupying are more than semidiameter of spinal cord, it is more frequent from the ventral side. In the formed areas it detected the fragments of tissue of brain, vessels and granulated spheres. In one case of the perforating penetrating wound of spine after only 3 weeks after wound A. Ya. Podgorny revealed/detected in the spinal cord the area by walls of which were joined solid, arachnoid and soft cerebral shells.

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Not always on the autopsy it is possible to macroscopically establish/install the focus of softening, especially with the nonpenetrating wounds.





Fig. 22. Hemorrhage in the right front/leading crescent of the seventh neck segment. Preparation VMM No 673. (Artist V. E. Busch.).



Fig. 23. Perforating fragmentation penetrating wound of spine with the decomposition of small arc of IX thoracic vertebra and the perforating wound of spinal cord at the level of the eleventh thoracic segment. Solid cerebral shell and part of soft are opened

from the posterior surface. The wound of slit-shaped form, has 9 mm in the diameter, higher than wound the evidently uneven swelling/distension of the substance of spinal cord (traumatic edema). The vessels of lumbar thickening are plethoric. Preparation VMM No 672. (Artist of T. V. Belyayev.).



Fig. 24. Perforating penetrating bullet wound of chest. Extensive contusion softening of spinal cord, beginning from the tenth thoracic segment and down, captures entire lumbar-sacral thickening. With

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respect to this place on the internal surface of solid cerebral shell the residual phenomena of hemorrhage in the form of a yellowish-brown pigmentation. (preparation VMM No 722. (Artist of T. V. Belyayev.).



Fig. 25. Blind-end bullet penetrating wound of VI thoracic vertebra without the damage of solid cerebral shell. In the longitudinal section the evidently traumatic softening of spinal cord for the

elongation/extent of almost four average/mean thoracic segments.  
Preparation VMM No 1013. (Artist of T. V. Belyayev.).

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With the more or less extensive foci of softening after loss of edema on the spot of softening along the length of brain comparatively easily was detected the sector of retraction (thinning). In this case in the cross section the characteristic figure of gray substance was always absent. But, when focus was arranged/located only in some unit of the white substance as, for example, in the front/leading or lateral columns, and also in the gray substance, for example, it is isolated/insulated in the front/leading crescent or in the basis of posterior genus, it remained unidentified and it was larger partly determined only during the histological investigation.

In the posterior columns are described the cuneate foci of softening according to the type of infarction (A. Ya. Podgorny).

If wounds by bullet shell or bone fragment were deposited intersegmental apparatus both in the region of intervertebral apertures and for the elongation/extent of the intra-tunicary cuts of rootlets, then in the substance of spinal cord were frequently

detected only the foci of micronecroses and the lighter reversible changes from the side of the elements/cells of nerve tissue.

The reverse changes include the retrograde degeneration which flows/occurs/lasts in the nerve cells of intervertebral ganglia/nodes and the groups of the motor cells of the corresponding segment, according to the type of axonal stimulation (Fig. 26).



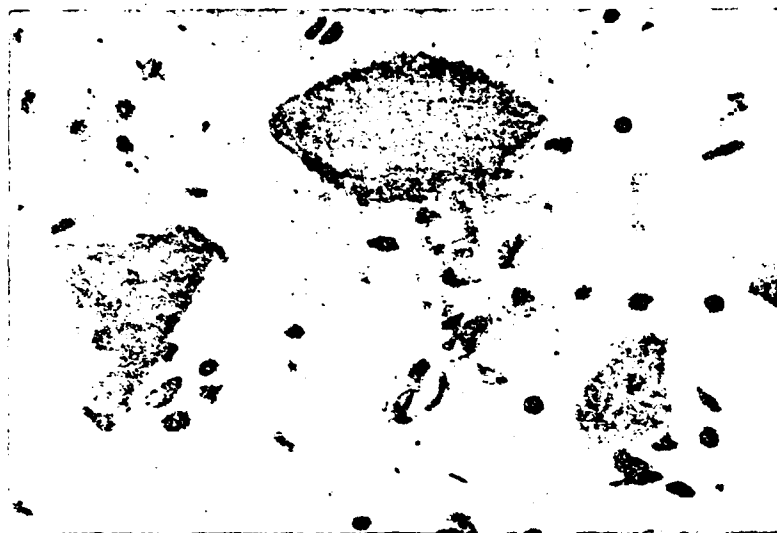


Fig. 26. Changes in the motor cells posterior-lateral of the group of the front/leading crescents of the third lumbar segment of spinal cord according to the type of axonal stimulation. Microphotogram. Preparation VMM No 2797. Stain/staining according to Nissl. VOMP. Ocular 8, objective 20.

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As is known, the essence of the axonal stimulation of nerve cells consists in the fact that the cellular bodies are rounded off (in the sensitive ganglia/nodes they are lengthened), Nissl substance becomes more rarefied, and then is melted, remaining only in the form of rim on the periphery of cellular body; the nucleus/kernel of cell is most

frequently invariable/unchanged and, as a rule, is displaced to the periphery of cell, and it is sometimes and ejected outside.

In this condition nerve cells can remain for a period of 3-4 weeks after trauma. Subsequently in the predominant majority of nerve cells was reduced normal picture, whereas their insignificant unit, apparently underwent deeper necrobiotic changes. Together with the described changes in the type of axonal stimulation, near the necrotized foci occurred the changes, which resembled the picture of the ischemic disease of nerve cells (homogenization of cellular body, wrinkled dark nucleus/kernel), and finally it was possible to note deep necrobiotic changes in the nerve cells, which appear as a result of pericellular edema (A. Ya. Podgorny, M. P. Postolov). Glial reaction during the traumatic processes occurred very limply. Proliferating phenomena from the side of glial elements/cells intensely came forward only in the presence of foreign body; with changed nerve cells only rarely it was possible to see glial knots or moderate diffuse proliferation. In dead persons in the hospitals the anatomical picture of the damages of the contained spinal canal was characterized by following data: the complete destruction of the diameter of spinal cord is noted into 39.30/o, of them full/total/complete anatomical interruption - into 28.60/o, contusion softening - into 10.80/o, the partial decomposition of the substance of spinal cord - into 27.80/o, locus necrosis and softening - into

17.3o/o, the compression of spinal cord - into 4.4o/o, the damages of horse tail - into 14.2c/o, hemorrhage into the shells of spinal cord - into 8.1o/o, hemorrhage into the substance of spinal cord - into 5.8o/o, the decomposition of rootlets and intervertebral ganglia/nodes - into 0.4o/o.

According to the data of autopsies, on the field of battle the full/total/complete interruption of spinal cord was discovered into 47.0o/o, partial damage into 22.0o/o, remaining 31.0o/o fall on the hemorrhages in membranes (17.0o/o) and into the substance of spinal cord (14.0o/o).

During the comparison of these data it is established that the greatest numerals relate to the heavy damages of spinal cord both with the full/total/complete and with the partial violation of its integrity. Relatively high percentage were also the damages of horse tail. On the field of battle, as one would expect, with the autopsies of dead persons in the sharp/acute period were encountered the relatively high numerals of hemorrhages into the shells and the substance of spinal cord, which in essence characterized the severity of the damages of spine as a whole.

Complications.

The developed infectious complications in the shells and the substance of spinal cord led in a number of cases to the fatal result on the 3-5th day after bullet wound.

With tetanus of any pathoanatomical special features/peculiarities in the tissue of spinal cord there was not. With it macroscopic changes were expressed only in insignificant hyperemia of the vessels of shells, that it did not give grounds to prosector to place pathcanatomical diagnosis.

The anaerobic infection, which developed within the spinal canal, was characterized by the extensive melting of the substance of spinal cord.

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However, in a number of cases toxic phenomena during the anaerobic infection in the cerebrospinal canal so rapidly led to death that the morphological changes in tissues macroscopically yet were not caught. In such cases clinical diagnosis, as with tetanus, it served as basis for the correct estimation of the available specific process, but without sufficiently expressed macroscopic data.

The early forms of spinal meningitides in the protocols of

autopsies were noted in the form first of focus ones, then of the more diffuse cloudiness of soft shells. The cloudiness of shells achieved the greatest intensity near the wound. Histologically such meningitides were characterized by the picture of serous-suppurative inflammation with the presence in infiltrates of predominantly polymorphonuclear leukocytes.

Massive suppurations in the shells and the substance of spinal cord were observed with the suppurative ones of process in the wound canal. These group unites the following suppurative complications: external suppurative pachymeningitis (according to some authors - pachymeningitis externa), epidural abscesses, which ascend suppurative leptomeningites, suppurative meningomyelitis, restricted suppurative leptomeningitis, abscesses of spinal cord. With of this type complications special importance acquired the character/nature of suppurative process in the wound canal.

As illustration to the aforesaid can serve the combined wounds of spine and abdominal area with the presence of ichorous-suppurative contents both in the external wound and in the soft shells for entire elongation/extent of back and on the basis brain (Fig. 27). These wounds, according to clinical epicrises, were always characterized by extremely heavy course.

External pachymeningitis. Suppuration in the epidural space most frequently was arranged/located on the dorsal surface and sometimes achieved considerable sizes/dimensions lengthwise. On the preparation of military medical museum No 837 this external pachymeningitis occupies in the diameter the space, the equal to  $3/4$  diameters of spinal cord (Fig. 28).

During the restricted encysted processes in the epidural space the accumulation of pus achieved such sizes/dimensions, that late surgical intervention did not remove the created compression of spinal cord.

External pachymeningitis frequently was developed after epidural hemorrhage. Macroscopically external pachymeningitis became apparent in the form of lamellar education from the granulating of education from the granulating tissue with the uneven surface, is frequently the loosely joined with the bones spine. Depending on the character/nature of process and period of death of casualty, this education had first) (in presence of hemorrhages reddish-brown, then yellowish-green (during the suppuration), then finally yellowish-gray color (with the developing already scar, depending on the degree of its maturity).

Solid cerebral shell during the external restricted process was

microscopically frequently edematic, with the expanded lymphatic slits and the perivascular infiltrates from the leukocytes, the lymphocytes, among them there were macrophages. Soon after wound the histological picture of external pachymeningitis was represented in the form of massive infiltrates from the fresh and decomposing leukocytes, a large number of giant cells and newly generating vessels.



Fig. 27. Blind-end combined with the abdominal area penetrating wound of spine at the level of the II lumbar vertebra. Sub-arachnoidal traumatic hemorrhage. Icteric-suppurative ascending cerebrospinal



meningitis. Preparation VMM No 1062. (Artist of T. V. Belyayev.).

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L. I. Smirnov considers that for pyo-productive external pachymeningitis is characteristic the growth of granulating tissue only over the external surface of the solid cerebral shell, which does not penetrate into its thickness. According to his data, granulating tissue is connected mainly with the skins of the osteochondral layer of the spinal column. In the series/number of preparations it observed the substitution of wound defect in the solid cerebral shell via the intergrowth of filaments and vessels from the osteochondral layer, and the granulating villi - from soft cerebral shells. One of the frequent reasons for the development of pachymeningitis was presence in the epidural space of the bone fragments of that or another value, which were delayed there at the moment of wound. During the histological investigation in such cases were detected the bone fragments, surrounded with granulating tissue. Usually already in the early stages of the formation of granulating tissue among the fibrous cells were secreted by their sizes/dimensions and stain/staining the osteoclasts which contributed to the resorption of bone fragments. Osteoclasts, as is known, are formed on mesenchymal syncytium or reticular tissue and are polynuclear education. Being introduced in the bone tissue, they

resorbed the latter, why in the reabsorbed bone fragment were formed different value areas and lacuna (Fig. 29 and 30), fragment gradually was decreased and frequently completely it disappeared.

The foreign bodies of another nature (metallic fragments, small pieces of tree/wood, different tissues, etc.), if they were not removed during the surgical treatment of wound, were usually covered/coated with dense fibrous tissue, around them were formed the restricted granulomas.

Suppurative ascending spinal leptomeningitis.

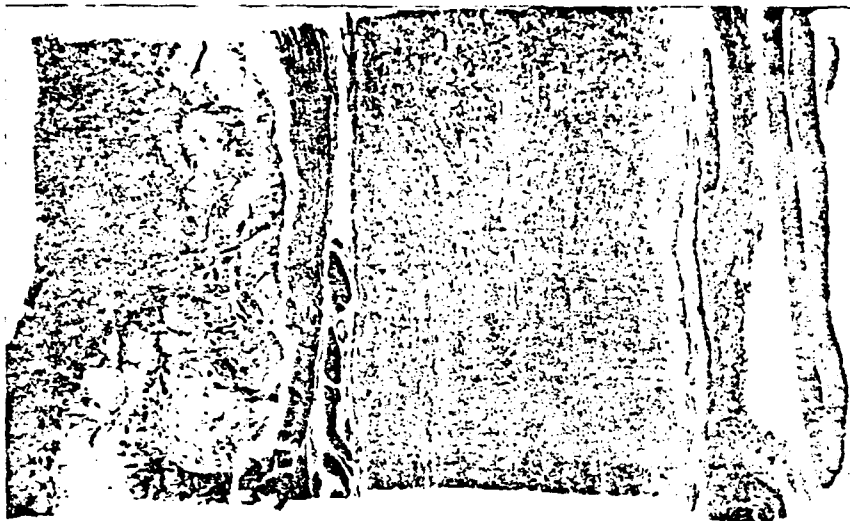


Fig. 28. External suppurative pachymeningitis after the bullet wound of the thoracic division of spine. Photogram from histological preparation VMM No 837.

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Fig. 29. Bone fragments in epidural cellulose, surrounded granulating tissue and undergoing resorption. Microphotogram. Preparation VMM No 3669. Stain/staining according to Nissl. VOMP. Ocular 8, objective 20.

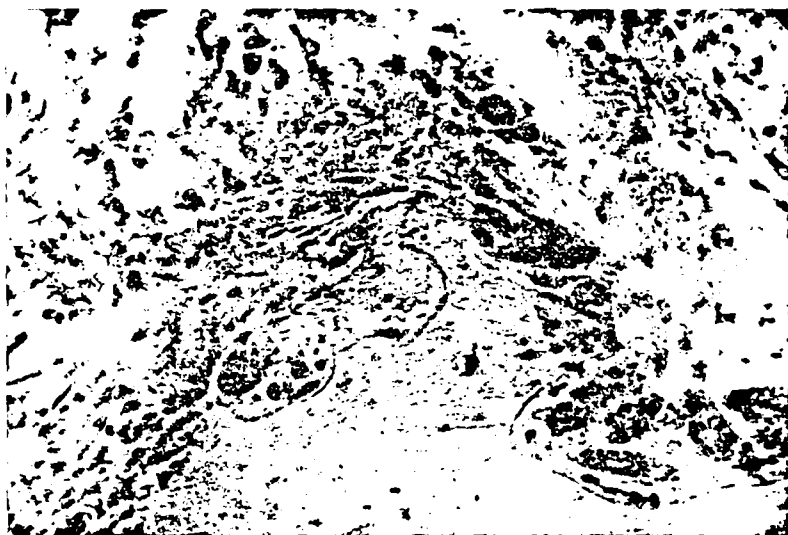


Fig. 30. The same preparation under great magnification. Resorption of bone fragment by osteoclasts.

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The macroscopic picture of this complication is typical. Solid cerebral shell both with that penetrating and with the nonpenetrating wounds was strained; with its autopsy in the majority of the cases was detected the diffuse massive accumulation of pus, which covers spinal cord for entire elongation/extent to the cone and to the basal surface of large cerebral hemispheres; in other cases pus was

arranged/located in the form of small islets, but also on entire length of spinal cord.

During the suppurative processes, usually in the form of foci, was detected hyperemia of pial vessels, and on the dorsal surface frequently was noted the thrombosis of veins (Fig. 31). Suppurative spinal meningitides appeared both with the penetrating into the spinal canal wounds and in the absence of any damages of the contained spinal canal.

In the development of suppurative meningitides with the integrity of spine large role played the suppurative processes, which were being developed in the neighborhood with them (festering interfascial, retroperitoneal and mediastinal hematomas, suppurative paranephritis, etc.), while in a number of cases suppurations in the bones of spine.

Histological changes with suppurative leptomeningitis, which developed after the wound of the contained spine, sometimes attacked/advanced very early. They were characterized first more, then by less massive by the volume accumulations of the polymorphonuclear leukocytes, which partly lie between the filaments of soft shell (Fig. 32 and 33), partly in the arachnoidal slits where, besides leukocytes, it was possible to see fibrin. The walls

of the vessels of shells, as a rule, underwent intense infiltration by both the leukocytes and histiocytic elements/cells. The periods of the onset of this complication were studied partly according to the data of clinico-anatomical comparisons. For the illustration we give the following observation.



Fig. 31. Mixed thrombus in the pial vein of the posterior surface of spinal cord. Meningomyelitis. Microphotogram. Preparation VMM No 997. Stain/staining with the hematoxylineosin. VOMP. ocular 8, objective 20.



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Fig. 32. Diffuse leptomeningitis. Microphotogram. Preparation VMM No 4153. Stain/staining with the nematoxilineosin. VOMP. ocular 8, objective 10.

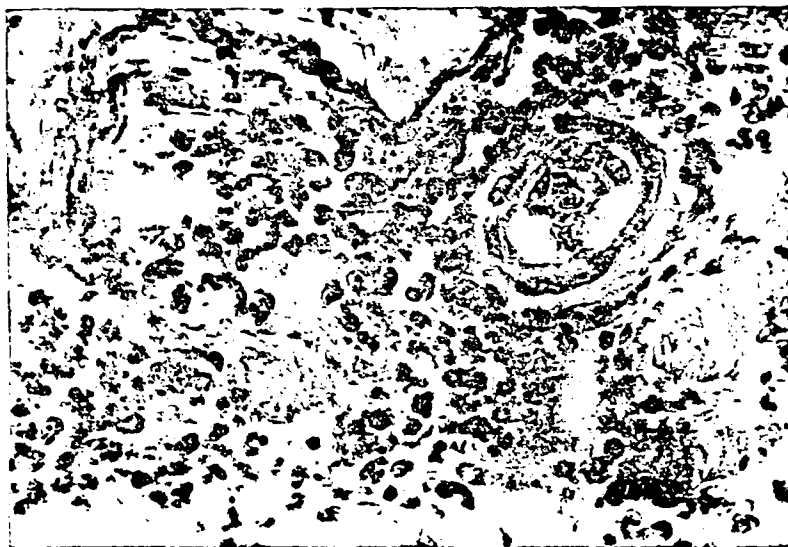


Fig. 33. Microphotogram from preparation VMM No 4153 under large magnification. Mixed infiltrate from the leukocytes and the lymphocytes between the thickened filaments of soft cerebral shell.

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K-is wounded by the fragment 29/I 1943. Clinical diagnosis: the penetrating wound of the lumbar division of spine with the partial damage of spinal cord.

Meningeal symptoms appeared on the third day after wound. 4/II is derivative the cerebrospinal puncture: fluid/liquid of reddish color, turbid; cytose 753/3 with the preponderance of leukocytes.

Treatment by sulfidine. 15/II casualty passed away.

Pathoanatomical data: the blind-end fragmentation penetrating wound at the level I and II lumbar vertebra with the damage of the small arcs of these vertebra and spinal cord at this level. Foreign body by the size/dimension 3x2x1 of cm is arranged/located among the bone fragments in the wound. Diffuse ascending meningitis with the massive accumulation of pus on the length of back and on the basis brain.

In the given observation is represented the typical picture of the course of suppurative postwound meningitis. Disease was continued 12 days; meningeal symptoms appeared on the 2nd day after wound with the considerable pleocytosis in the cerebro-spinal fluid.

During 12 days the cellular composition of infiltrates in the soft shells was changed. The leukocyte stage of inflammatory infiltrate after the first 3-5 days somewhat calmed down, and to the polymorphonuclear leukocytes, which are partly found already in disintegration condition, was mixed/added a considerable quantity of round cell elements/cells (of type of histiocytic ones) and a small number of plasma cells.

Frequently the picture of the mixed infiltrates they

supplemented macrophages. This cellular composition was detected usually in the cases of postwound ascending leptomeningitis, which arose in the first 2-4 weeks after wound.

In the form of illustration we give following data of pathoanatomical study.

Subst. it is equal to 19/VII 1944 by bullet. It died 18/VIII 1944. Pathoanatomical diagnosis: the blind-end bullet penetrating wound at the level of III thoracic vertebra with the full/total/complete interruption of spinal cord. Diffuse spinal-cerebral leptomeningitis. Bedsore in the region of rump. Gangrenous cystitis (prosector-Lieutenant Colonel of medical service A. V. Smol'yannikov).

During the histological investigation is discovered the mixed diffuse infiltration of the soft shells of pial vessels, and also spinal rootlets. In such cases always focused attention the sharp thickening of the filaments of soft shell.

Suppurative ascending or restricted leptomeningites with closed external wound, as has already been indicated, appeared by the lymphohematogenic route/path (suppurative emboli, thrombophlebitides) from the suppurative foci, which lie in the neighborhood with the

spine or at the spine itself (osteomyelitic foci), and also they were developed in the presence of external pachymeningitis. Both in that and in other case complication more frequently appeared in the intermediate, and sometimes also in the late period and flowed/occurred/lasted more slowly. In the morphological relation the late emergent complications in the shells of spinal cord had that special feature/peculiarity, that the leukocyte infiltrates and macrophages in these cases sometimes were absent, and histological picture was characterized by the proliferation of round cell elements/cells with the presence among them only of plasma cells.

To the local restricted processes from the side of soft cerebral shell should be related also adhesive (productive) arachnoidites. This form/species of complications usually was localized in the region of wound, for the elongation/extent of several segments. Intensely growing around the spinal rootlets, fibrous tissue filled all arachnoidal slits, without penetrating, however, the thickness of rootlets (Fig. 34). Frequently in the last stages after wound in this growing tissue proved to be the cystic areas or the areas, filled with pus.

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In the substance of spinal cord the suppurations, as a rule,

were spread only to several series/number of the lying/horizontal segments. Most frequently they appeared as a result of the direct contact with suppurative contents of entire wound canal and, in particular, shells. The suppuration, which flowed/occurred/lasted frequently with the melting of the substance of brain, macroscopically easily was determined. In the longitudinal sections usually came forward the sector of the softened substance of the spinal cord of the yellowish-green or dull gray color.

Thus, the suppuration, which was beginning usually in the zone of wound, frequently captured several segments. In the necrotized tissue perivascular leukocyte and lymphocytic infiltrates were encountered everywhere, while in the preserved normal anatomical relation segments they without any selectivity were arranged/located in the white and gray substance.

Just as in the shells, in the substance of spinal cord inflammatory process appeared via the transfer of infection from the suppurative focus, located near the spinal cord (Fig. 35).

In this respect convincing were myelitides, which developed in a small number of nonpenetrating wounds. The histological picture of such myelitides is completely similar to myelitides, which arose as a result of the direct contact with the wound infection (Fig. 36).

Complications of septic character/nature. The large group of complications in the army and front line area composed the septic diseases, which proceed from the urine excretory system which were isolated into the the special group-urosepsis (I. V. Davydovskiy, A. I. Vasil'yev).



Fig. 34. Productive arachnoiditis in the region of posterior rootlets of the first lumbar segment. Microphotogram. Preparation VHM No 102. Stain/staining hematoxylin-zozin. VOMP. Ocular 8, objective 20.





Fig. 35. Suppurative myelitis. Blind-end fragmentation penetrating wound of spine at the level of the VIII and IX thoracic vertebra with softening of spinal cord from the compression by metallic fragment at

the level of lower thoracic segments. In the longitudinal section the substance of spinal cord on the spot of compression is higher than the grey-brown color, it is unstructured. Preparation VMM No 59. (Artist of T. V. Belyayev.).

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Under urosepsis is implied the ascending suppurative infection of urinary tracts with the dissemination of process to the kidney tissue inclusively.

In the frequency of complications, together with this process, stood the septicemia, which was being developed with the presence of bedsorcs or different paravertebral ones and another localization of phlegmons, festering hematomas (interfascial, retroperitoneal, mediastinal, etc.) and osteomyelitic foci.

On the autopsy of twigs/roads in the presence of urosepsis most frequently it was detected diptheritic, pyo-hemorrhagic or pyonecrotic cystitis and fibrinogenous-suppurative and pyo-hemorrhagic pyelitis and suppurative nephritis. In this case the pyonecrotic cystitis in a number of cases was the source of so-called urocystogenic peritonitis, as a rule, which are finished with the fatal result (Ye. A. Terpugov). Clinical observations showed that at

the basis of the complications of this group, just as at genesis of bedsores, lay/rested the heavy dystrophic changes, caused by the damage of spinal vegetative centers (A. M. Wiechert, O. V. Nikolayev, A. L. Polenov, Ye. A. Terpugov et al.).

Special interest in pathoanatomical investigations of the enumerated diseases of urinogenous etiology arose during the Great Patriotic War in connection with the wide application of cystostomy. In this respect of considerable attention they deserve the investigation of A. M. Wiechert. Working in the army and front line area, it traced in the periods of development the pathoanatomical changes in the urinary tracts, which appear with the wounds of spine. Moreover, in these investigations is valuable the comparison of histological changes in the urinary system in those, who were subjected to cystostomy, and in those treated it is conservative.

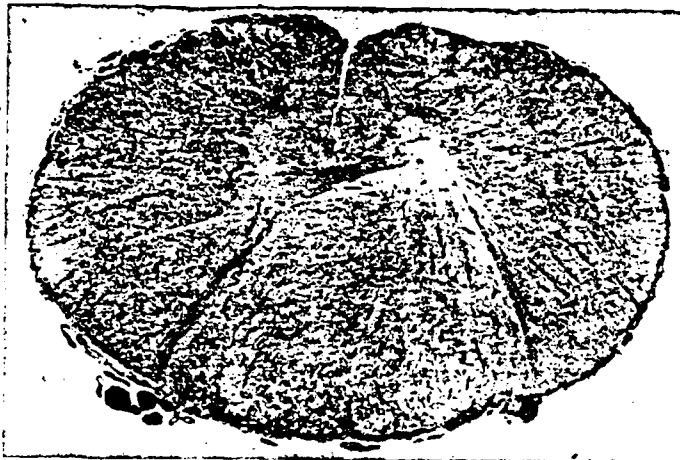


Fig. 36. Diffuse myelitis at the level of the eighth neck segment of spinal cord after nonpenetrating fragmentation wound of the mesothoracic division of spine. Histo-topographic image. Preparation VMM No 691. Stain/staining with the hematoxilineosin.

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On the basis of findings A. M. Wiechert comes to the following conclusions. Earliest changes in the urinary tracts which can be observed already to the first-second day after the wound of spinal cord, became apparent in the form of the disorders of blood circulation before the education of intramural hematomas inclusively. These changes were conditioned on paralysis of vasomotor nerves. As a result of disorders of blood circulation in tissues appeared hypoxia

and anoxia and to the violation of metabolism/exchange. From second-third day after wound in the bladder was observed the development of the necroses whose onset is connected, on one hand, with the disorders of blood circulation, and on the other hand - by the mechanical pressure of urine of the constantly overfilled bladder. Necroses, after arising in the places of the most sharply pronounced disorders of blood circulation in the zone of hemorrhages, subsequently progressed; within the later periods entire mucous membrane, submucous and sometimes muscular layer of the bladder underwent necrosis.

In origin and development of the necroses of mucous membrane and kidney parenchyma, as is shown the comparison of the cases, treated conservatively, with the operated cases, the bacteria did not play the leading role. Bacteria in the tissues appeared in the later periods when basic changes, necroses, were already present. However, the presence of bacteria in a number of cases conditioned the development of new complications, first of all pyelonephritis and urosepsis.

The necessary prerequisite/premise for the generalization of infection in the system of urine excretory organs/controls were the functional violations, which constantly occurred with the wounds of spinal cord (paralysis of the bladder, prolonged stagnation of

urine). The operation/process of the superpubic section of the bladder removed to a certain extent these functional violations and prevented the onset of both necrotic cystitis and complications, connected with the generalization of infection.

In the practical sense given data of A. M. Wiechert deserve attention, first of all, because they give the morphological substantiation for the rational use/application of superpubic section of the bladder, which prevents the complications, which lead, as a rule, to the lethal outcomes.

Macroscopic changes of the organs/controls of urine excretory system during the first 3-5 days after wound are sufficiently characteristic. The bladder, if it was not produced cystostomy, as a rule, was expanded and contained 600-800 cm<sup>3</sup> of turbid eyes, but sometimes also it is more. Mucosa of the bladder was swelled, it is sharply hyperemized, with the numerous hemorrhages, near which were noted the surface ulcerations/pittings of brown-gray or brown color; the walls of the bladder were frequently edematic.

Kidney pelvises were expanded against the background of stagnant plethora mucosa them was edematic and it is unevenly covered with mucopurulent or fibrinogenous impositions. Greatly frequently in the submucous layer were detected fine/small, with places flowing

together, hemorrhages. Thus, was a pathoanatomical picture of hemorrhagic suppurative or fibrous-suppurative pyelitis. The tissue of kidney in the presence of the described changes in the pelvises was pale, hardly by the distinguished figure of cortical and medullary layer. Histological investigation usually showed necrotic changes, beginning from the renal scuphuli to the epithelium of ducts inclusively with the leukocyte infiltration of interstitial tissue and ducts.

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The early appeared after bullet wounds characteristic pathomorphological changes in the urinary organs/controls are illustrated by the following observations.

(Patient) S-o is wounded by the fragment 6/XII 1943, it died 9/XII 1943. Pathoanatomical diagnosis: the fragmentation wound of neck with the break of the awned extension of the V neck vertebra. The contusion of spinal cord at the level of the V and VI neck vertebra; diffuse, purulent, spinal leptopachymeningitis. Diphtheritic ulcerous cystitis and ascending pyelonephritis. Urosepsis. Histological description of the wall of the bladder: the necrosis of mucosa, which captures partially and submucous layer. On the boundary with the necrosis massive polymorphonuclear infiltrate (zone of demarcation inflammation). Edema of submucous and muscular layer (Fig. 37. Specimen of the military medical museum No 1722).

Death of this wounded with contusion damage spinal cord at the level of lower neck segments advanced on the 4th day after wound. In



the pathological-anatomical diagnosis, together with the suppurative complication, in the shells of spinal cord was noted also urosepsis source of which was diphtheritic ulcerous cystitis and ascending pyelonephritis.

(Patient)  
Ya-kiy is wounded 20/XII 1942, it died 9/I 1943. Clinical diagnosis: the perforating bullet wound of the IV lumbar vertebra with the damage of the filaments of horse tail at this level. Bedsores of lumbar region, rump and nates. Bilateral bronchopneumonia. Septic condition. General/common/total depletion.

Pathoanatomical diagnosis: the perforating bullet wound of lumbar region with the break of body of the IV-V lumbar vertebra, with the decomposition of the filaments of horse tail at this level and the damage of the ends of right iliac bone. The ascending fibrinogenous-suppurative pyelonephritis. Urosepsis (prosector of A. V. Nemilov). Preparation of the military medical museum No 1719, left kidney. Kidney by the size/dimension 12x6 cm. Fibrous capsule is taken/removed. Pelvis is sharply expanded. Mucosa for entire elongation/extent of dark-red color, by places with the hemorrhages, is covered with fibrinogenous-suppurative impositions (diphtheritic pyelonephritis).

The tissue of kidney flaccid, boundary between the crust and

cerebral substance unclear, figure it is almost effaced (Fig. 38).

In this case the wound of the lower unit of the spine ended by death on the 20th day after wound directly from urosepsis source of which was the ascending fibrinogenic-suppurative pyelonephritis.

(Patient)

B-v is wounded 2/IV 1944, <sup>he</sup> died 28/IV 1944. Clinical diagnosis: the blind-end fragmentation wound of breast with the wound of spine. Sepsis. Bilateral pneumonia. Pathoanatomical diagnosis: the perforating bullet wound of neck and breast to the left. Hemorrhage in the epidural cellular tissue of the neck and thoracic division of spine. Softening the substance of spinal cord at the level of the III-V thoracic vertebra. Bedsores. A fibrinogenous-necrotic cystitis (Fig. 39). Pyelonephritis. Urosepsis (prosector the Major of medical service F. Ye. Ageychenko). Preparation of the military medical museum No 2598. Kidney is increased in the sizes/dimensions, capsule is taken/removed without the defect of substance. Tissue almost variegated, boundaries of crust and cerebral substance are ill-defined. Pelvis is expanded, mucosa is covered with the tightly sitting gray coating. During the histological investigation is discovered typical diphtheritic pyelitis and the ascending suppurative interstitial nephritis (Fig. 40).

In this observation with the combined wound of spine and chest

was discovered the focus of softening in the upper thoracic division of spinal cord. Just as in the preceding case, death advanced on the 26th day from urosepsis; by the source of urosepsis was a fibrinogenous-necrotic cystitis pyelonephritis with the pyonecrotic changes in the parenchyma of kidneys.

Thus, on the basis of the given macroscopic and histological changes, which were being developed in the urinary system within the earliest periods, it should be pointed out that at the basis of these changes lay/rested the necrotic and inflammatory processes. The onset of these processes, on one hand, is connected with the decomposition of vegetative spinal centers, and on the other hand - with those conditions which created functional violations in these organs/controls upon the introduction in them of bacterial flora.

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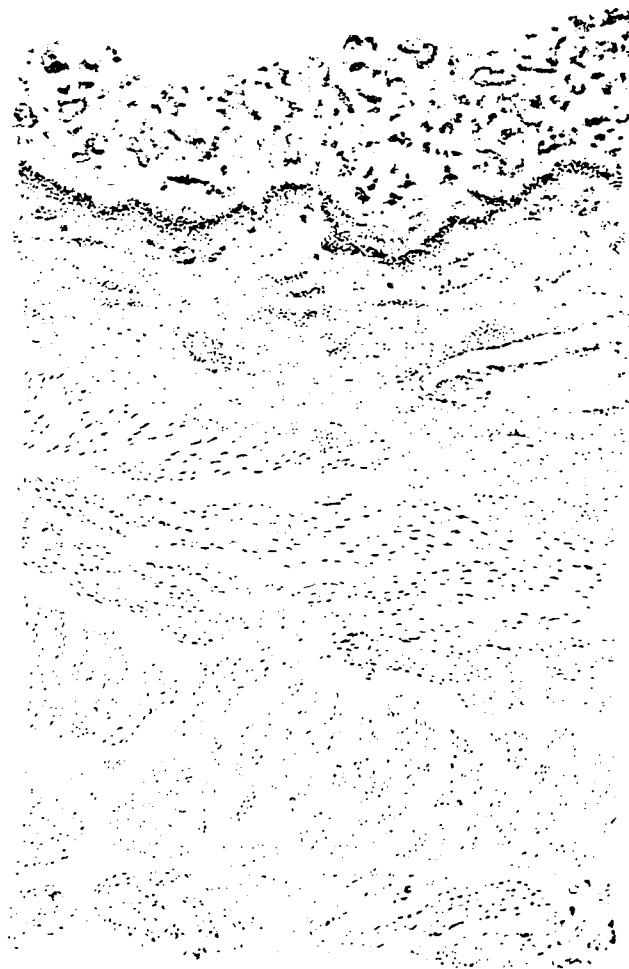


Fig. 37. Necrosis of muccsa of bladder. Edema of submucous and muscular layer. Preparation VMN No 1722. (Artist V. E. Busch.).

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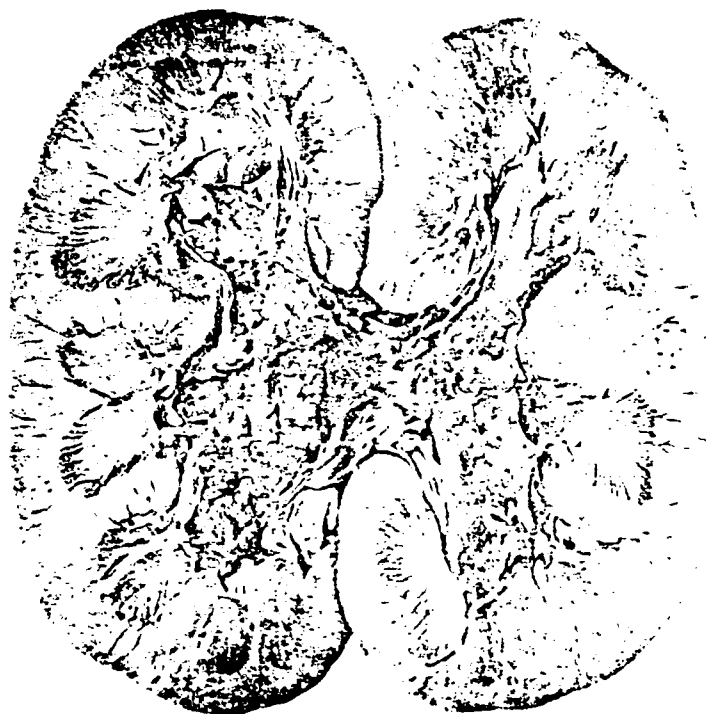


Fig. 38. Frontal section/cut of left kidney. Diphtheritic pyelonephritis. Preparation VMM No 1719. (Artist V. S. Chumanova.).

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Fig. 39. Left kidney. Necrosis of the mucous membrane of kidney scuphulus. Microphotogram. Preparation VMM No 2598. Stain/staining with the hematoxilineosin. VCM2. Ocular 8, objective 10.



Fig. 40. The same preparation. Massive polymorphonuclear infiltrates in the interstitial tissue of the cerebral substance of kidney. Accumulation of polymorphonuclear leukocytes and necrosis of the epithelium of the collecting tubes of canals. VOMP. Ocular 8, objective 20.

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But, naturally, within whatever period after wound appeared this complication, initial pathomorphological changes they were identical recently given.

Bedsore. One of the frequent forms/species of complications

with the wound of spine were bedsores. They appeared in the sacral, heel region and above the large trochanters of thighs, it is thinner/less frequent in the region of elbow joints and spatulas. Their pathoanatomical picture in the initial period of disease was represented in the form first of the sectors of dry gangrene, then of foci with the crawling edges and the bottom of dirty green color, with the unpleasant rotting odor. At the specific stage of the development of gangrenous process were uncovered the bones with subsequent osteonecrosis and osteitis, or osteomyelitis. Frequently bedsores were formed simultaneously in several regions (rump, thigh) (Fig. 41).

N. I. Chekalova gives the series/number of her observations when bedsores were arranged/located on the internal surface of knee joints with the melting of articular bursae and the development of purulent gonites.

Pneumonia. In the protocols of autopsies usually was given as the reason for death fine focal/acinous scattered or drainage one-sided less frequently thinner/less frequent bilateral bronchopneumonia. Frequently pneumonia flowed/occurred/lasted with the phenomena of edema and by initial necrotic ones change. Present gangrenous pneumonia were encountered only in the presence of aspiration, i.e., with the simultaneous wound of spine and jaws or



upper respiratory tract.

T. S. Istamanova noted catarrhal pneumonia almost in the half those all obtained the wounds of spine. According to her data a great number of pneumonia is discovered with the wounds of neck and thoracic division, whereas with the wounds of lumbar division pneumonia was encountered six times more thinly/less frequently, and the wound of sacral region in the tenths of percentage it was only complicated by pneumonia. In the pathogenesis of such pneumonia the author perceives the disorder of the coordination of respiration, the violation of visceral vasomotor innervation, the delay of mucus and the activation of autoinfection of the respiratory tract.

Osteomyelitis. Purulent processes in the bones of spine in the cases, which were finished lethally, in comparison with other complications occupied small place.



Fig. 41. Extensive bedsores in the region of rump and thighs.  
Preparation VMM No 4197.

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Usually they were developed in the region of wound and then they converted/transferred to the undamaged/uninjured vertebrae, frequently capturing on 3-4 vertebrae even more (Fig. 42). Thinner/less frequent osteomyelitis of spine was developed near phlegmon. As showed the clinical X-ray observations, especially frequently suppuration was noted in the damaged bodies of vertebrae. This is completely explained, if we consider the vastness of the

necrotized masses, which are generated as a result of wound in the porous substance of the body of vertebra, and the free access to infection into this unit of the vertebra. Bullet osteomyelitis usually consider as the combination of two processes - necrosis and suppurative (pyo- fibrinogenous and pyoputrefactive) inflammation.

Inflammatory process in the damaged unit of the spine as early complication was developed already at the end of the first week after wound. With the autopsy of spine was noted the kill of the edge of the bone wound: porous substance, as a rule, within this period was impregnated with the blood and pus and had yellowish or sulfur-red color. Necrotic-inflammatory phenomena with bullet osteomyelitis of different bones, according to M. K. Dal's data, they were continued on the average to 2 weeks. A. P. Avtsyn he indicates, that the x-ray examination of tubular bones established/installed pathological-anatomical changes in the inflammatory character/nature 2-4 weeks after wound. In the protocols of autopsies frequently was noted for a period of the 3rd and 4th week the intensely elapsing inflammatory process. Considerably thinner/less frequent in these periods was discovered the development of granulating tissue. The development of osteosclerosis (consolidation) was observed from 4-6-th the month after wound, that confirm clinical data. During the development in the vertebrae of the inflammatory changes, which appear on the elongation/extent, were destroyed mainly the bodies of

vertebrae.

This in the identical measure was observed both with the localization of inflammatory focus in the bone unit (wound osteomyelitis) and during its development from phlegmon of the surrounding soft tissues. Chronic osteomyelitis were sufficiently frequent complication in the hospitals of front rear. They were usually characterized by the education of those not long healing fistulas, frequently with the sequestration of bone fragments.

It is difficult to reliably establish/install the reasons, which support in the bone tissue inflammatory process in those wounded the spine with the damage of spinal cord. On one hand, the lowered/reduced general/common/total resistivity of organism and the violation of trophic system in such wounded, while on the other hand, the presence of other suppurative foci (bedsores) played not latter/last role in the pathogenesis of chronic osteomyelitis. Osteomyelitic foci in a number of cases were the sources of the suppurations in the shells and of the substance of spinal cord, and also they led to the development of sepsis.



Fig. 42. Osteomyelitis of the bodies of neck vertebrae after the bullet wound of the soft tissues of neck. Preparation VMM No 3681.

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Both in the late and in the earlier period with osteomyelitic complications on the autopsy were detected fistula courses. Sometimes such courses were the considerable range: for example, in one case fistula canal of an iliac-sacral articulation (osteomyelitic focus) was opened/disclosed at the level of the cross extension of the II lumbar vertebra. Most frequently with chronic bullet osteomyelitis of spine pus was separated/liberated through the fistula courses among the scar tissue.

L. I. Smirnov on the basis of the pathomorphological investigations of the bullet wounds of spine, carried out by it during the Great Patriotic War, unites all means of appearing in this case pathological-anatomical changes in the spinal cord and its shells into four basic groups.

1. Traumatic necroses (primary and secondary): process of healing of wounds of spinal cord and its shells; disorder of circulation of blood and cerebro-spinal fluid; presence of foreign bodies in area of spine.

2. Reactions of frontier and distant tissues to products of tissue decomposition/decay and to foreign bodies, to circulatory and trophic disorders (secondary necroses, edematic meltings, nonpurulent myelitides and leptomeningites, diffuse and restricted glial reactions, development of granulating tissue in periphery of foreign bodies, ascending and descending degenerations).

3. Complications of infectious and discirculatory character/nature (suppurative external pachymeningitis and phlegmonose epiduritis, festering wound, suppurative myelitis, which ascends spinal leptomeningitis, festering scar).

4. Complications, connected with fallout of functions, which appear with wound of spinal cord (have in mind trophic cystitides, pyelonephrites, bedsores, pneumonia, etc.).

The given above description data of the pathoanatomical studies, which reflect the experience of the army and front line anatomical pathologists, in essence will agree with this systematization of all pathological processes, which appear with the bullet wounds of spine.

However, this question as the healing of the wounds of spinal cord, in view of the series/number of morphological special features/peculiarities, should be considered as the final phase of the issues of wounds.

Primary necroses in the spinal cord appeared on the spot of the activity of the wounding shell and on the edges of wound canal or as a result of compression, contusion, and also elongation of spinal cord and its rootlets.

Secondary necroses composed one of the main pathomorphological phenomena which expanded the region of tissue decomposition in wound and led to the onset of new necrobiotic foci. To the education of

secondary necroses frequently contributed pachymeningitis, foreign bodies, violations of root and lymph circulations to the stasis inclusively, compression by the units of the destroyed ligamentous/connecting apparatus (yellow ligament) and cicatrical growths. In view of this diversity of genesis secondary necroses appeared in different periods after wound and made the condition worse of the partially damaged spinal cord, most frequently at the height of the development of septic phenomena.

The effect of septic condition on the development of the secondary necroses, which made the course worse of myelitides, it was noted frequently and in the clinical observations.

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According to the observations of A. N. Bakulev, the partial damage of spinal cord, discovered during the operation/process, was finished during the development of septic condition with the full/total/complete melting of the substance of spinal cord on the diameter and it led to the full/total/complete anatomical interruption.

Among the suppurative complications deserves attention the morphological determination of epidural abscesses and abscesses in



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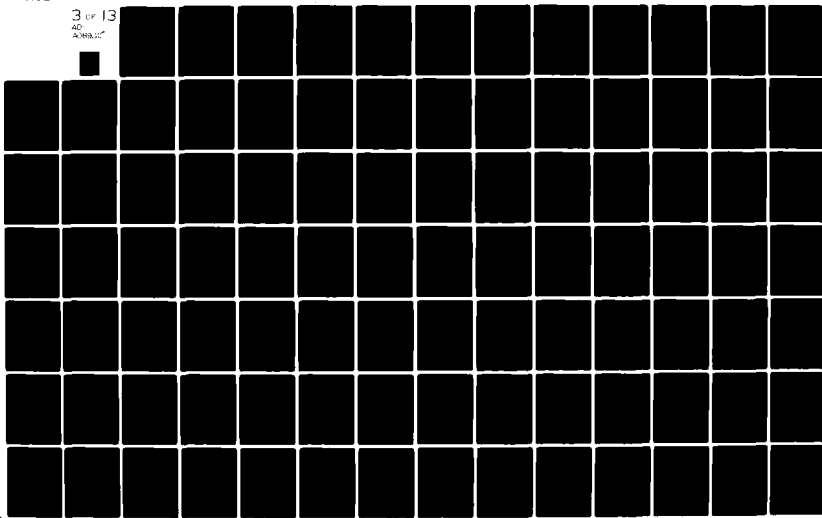
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EXPERIENCE OF SOVIET MEDICINE IN A GREAT PATRIOTIC WAR 1941-194--ETC(U)  
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the spinal cord.

The frequency of actual abscesses with the presence of pyogenic membrane/diaphragm, as under conditions of peacetime, with the bullet wounds it is small. As it was possible to establish/install on the protocols of autopsies, under this diagnosis frequently were described the restricted accumulations of pus around the foreign body or without it, on the external surface of solid cerebral shell, in the soft shells and in the substance of spinal cord.

I. V. Davydovskiy indicates that on the course of wound canal can appear the separate isolated/insulated accumulations of pus, which remind the abscesses of wound canal. This type of accumulations of pus were noted on the autopsies of dead persons from the wounds of spine, especially with the combined wounds. The given point of view for the morphological representation about the abscesses should be transferred also to the contents of spinal canal, which will to a considerable extent remove frequently encountered in this respect noncoincidences of clinical and anatomical diagnoses.

Cleansing and healing of the wounds of spinal cord - long elapsing process. The resorption of the fission products of myeline and blood clots in the region of the focus of softening, just as in the brain, can be drawn by years. Begins this process already during

the first days after wound, as soon as appear macrophages. The process of cleansing in the damaged substance of spinal cord proceeds considerably more rapid only with the damaged solid cerebral shell. With the penetrating wounds of spinal cord without the damage to the latter the resorption of the destructively changed unit of the brain is involved/tightened for a long time.

The healing of the wounds of spinal cord during the favorable course was usually escorted/tracked by different intensity of the growth of young connective tissue. In the soft shells this preceded initial adhesive arachnoiditis and then it already protruded coarsening of scar as the method of the development of fibrous tissue. Within the later periods the insignificant arachnoidal growth either were resolved or, which occurred more frequently, they were converted into the dense cicatrical education which should be considered as the fibrous arachnoiditis. These growths of fibrous tissue, penetrating the thickness of solid cerebral shell, led to the development of scarry depressions. The formed scar replaced wound defects both in the cerebral shells and in the substance of spinal cord.

In the presence of the foci of necrosis in the brain tissue already to the 3rd week were formed the areas with the well expressed connective walls. Similar small areas subsequently wholly occluded

and were the massive connective scar, which consists in such cases of the older coarsened and younger filaments.

With the autopsy of the dead persons after a year and more after the wound of spine, besides recently described Rubtsovs changes and presences of cystic areas, in the spinal cord were detected also the cysts on the spot of those been more or less large/coarse hemorrhages. Latter/last form/species areas were encountered in the epidural space, in the scars, especially in the region of horse tail, and finally in the brain tissue.

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#### Chapter IV.

General/common/total questions of clinic of bullet wounds and damages of spine and spinal cord.

Corresponding member of the Academy of medical Sciences of the USSR honored worker of science professor I. R. Razdol'skiy.

Periods in a course of bullet wounds of spine and spinal cord.

In the clinical course of bullet wounds and damages of spine and spinal cord, as showed the experiment/experience of the Great Patriotic War, should be distinguished four periods: 1) sharp/acute, 2) early, 3) intermediate and 4) late.

Sharp/acute period covers the first 2-3 days. In the neurologic relation this period can be defined as "chaotic" by analogy with "chaotic period" during the damages of brain, isolated N. N. Burdenko.

In sharp/acute period the clinical manifestations of different

wounds and damages of spinal cord are similar. The wounds of spine were frequently complicated by traumatic shock and sharp/acute anemia in connection with the blood loss. These complications in combination with the damage of other vital organs/controls were frequently the reason for "sharp/acute death" in the quite foremost stages of evacuation. In the unit of the cases with the wounds of the lower-thoracic and lumbar division of spine were noted retroperitoneal hematomas, which were escorted/tracked by peritoneal syndrome with the picture of "sharp/acute stomach" (stimulation of sympathetic ganglia of the lumbar division of frontier shaft) and they sometimes even impelled surgeons to the test laparotomy/ceiotomy.

Early period covers the subsequent 2-3 weeks after wound. In this period usually became apparent anaerobic infection. Neurologic in the early, as in the sharp/acute, the period in the majority of the cases of the most diverse wounds (penetrating, nonpenetrating, and also paravertebral) was noted the syndrome of the full/total/complete violation of the conductivity of spinal cord. In the pathogenesis of this syndrome were multifeature reasons and among them spinal shock, violations of roof, lympho- and liquor circulation, and also microstructural changes in the parenchyma of spinal cord as a result of the associated jolt and its contusion.

Experiment/experience showed that the reversible changes, not connected with the rough damage of spinal cord (edema and bloating), usually disappeared toward the end of the early period.

One should add that for the early period of the damages of spinal cord is characteristic the appearance of complications from the side of the urinary tracts, and also the onset of bedsores and pneumonia of different origin.

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In the early period the estimation of clinical picture presented for the neuropathologists serious difficulties.

To solve a question about the need for radical surgical intervention in the early period was extremely difficult, and correct topic diagnosis is frequently impossible.

Toward the end of this period already clearly was revealed/detected the beginning of the series/number of infectious complications from the side of abdominal and chest area with the combined wounds which received full/total/complete development in the following period.

Intermediate period lasts to 2-3 months. In its initial phase were eliminated the phenomena of spinal shock. In the same phase noticeably was cleaned the wound after its dissection in the foremost stages. Under the favorable conditions in this period the wound healed. To the 3-4th week more or less were drawn the actual sizes of the damage of spinal cord and its character/nature (full/total/complete transverse contamination, partial damage, contusion of spinal cord, hematomyelia, etc.). Under the favorable conditions this period coincided with the period of the "reduction of functions". Under the unfavorable conditions the wounded comparatively rarely survived this period, since in the time it coincided with the maximum development of different early complications.

Depending on degree and level of the damages of spinal cord, in the beginning of intermediate period already achieved considerable development the bedsores in the region of rump, large trochanters and other projecting divisions spines and bodies.

In the absence of proper prophylaxis and departure/attendance the complications of trophic and infectious character/nature in the urinary tracts rapidly progressed, which by itself or in combination with the infection from the wound and the bedsores led to the development of sepsis.



The violation of protein metabolism/exchange in combination with the infection (urinary tract, wound, bedsores) and frequently with the exhausting diarrheas led to the development of wound cachexia. With the combined wounds already at the very beginning of this period or at the end of the early period appeared terrible, risky for the life complications from the side of the organs/controllers of chest (suppurative pleurisy, mediastinitis, traumatic pneumonia, etc.) and abdominal area (peritonitis, diseases of parenchymatous organs/controllers). In the same period were developed suppurative processes in the bones (osteomyelitis), the shells of brain (meningitis, epidural abscess) and in the spinal cord.

Under the favorable conditions, in the cases of the insignificant damage of spinal cord and taking of the proper measures in this of the period of wound, more or less fully was reduced the function of the bladder. After the liquidation of complications the "traumatic disease/sickness/illness/malady" of spine and spinal cord converted/transferred into the fourth, or the late, the period.

Late period began from 3-4-th months after wound and was continued not defined for long (2-3 years and more). Neurologic this period was characterized by further progressive, very slow reduction

of the functions of spinal cord; it was reduced automatism of the divisions of spinal cord, arranged/located down from the level of full/total/complete cross interruption, and also were reduced the functions of the preserved elements/cells of spinal cord during its partial damage. A considerable number of observations attests to the fact that even after 5 years the process of reduction of functions it was not possible to consider finally completed.

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In the same period were developed late complications in the spinal cord, its shells and rootlets (pachymeningitis, arachnoiditis, meningoradiculitis, discirculatory violations, etc.). In the initial phase of this period were already observed changes in the spine in connection with the organization of the callus, the dynamics of osteomyelitic process, which led sometimes both to the late deterioration of functions of spinal cord, to radicular pains and to aggravation of process in the shells and to the violation of statics. The infection of the urinary tracts in this period extinguished or, being periodically peaked, it gave the outbreaks of cystitis or pyelitis. The violations of urination remained frequently for a prolonged time, especially afterward the more or less considerable damage of spinal cord.

In this period was observed the formation of concretions in the urinary tracts, and also the series/number of considerable morphological changes in them (expansion of tail end of the urethra, strain and change in the capacity of the bladder, various forms of cystitis, expansion of pelvises, etc.).

The outbreak of the infection of the urinary tracts within the late periods after wound can prove to be fateful for the wounded.

Are known the cases of longevity even with the full/total/complete anatomical interruption of the spinal cord (patients lived by 10-15 and more than years after wound; A. L. Polenov), but considerably more frequent in the late period the relapse of the infection of the urinary tracts led these wounded to death. On the contrary, wounded, who withstood contusion or partial damage of spinal cord, in this period gradually returned to the work.

General/common/total symptomatology of bullet wounds and damages of spinal cord.

The experiment/experience of the Great Patriotic War it is considerable expanded and to angle it broke the existed representations according to the series/number of general/common/total and particular questions of clinic of bullet

wounds and damages of spinal cord, which remained little illuminated after the first world war.

General condition of wounded in a sharp/acute period.

The appearance of wounded, their general condition and behavior in essence depend on the severity of the damage of spinal cord, localization of damage and severity of the associated damage of internal organs/controls.

During the heavy damages of brain the majority of wounded as a result the general/common/total, but more frequent than cerebrospinal shock during the first hours and the days either did not test/experience pains or experienced insignificant pain in the region of wound. They are flaccid, apathetic, patient, rarely somewhat euphoric. Without testing/experiencing pains and without being aware in the possible consequences of wound, they during the first days comparatively easily reconcile themselves with their position/situation, but subsequently, in proportion to the realization of the severity of its position/situation, many of them became closed, oppressed.

Full/total/complete contrast to them represented wounded with the partial damage of horse tail or with the jamming (without the

full/total/complete damage) or any posterior rootlets by the wounding shell or by bone fragment. This many wounded groups experienced cruel pain, which caused to them heavy sufferings. They were agitated: they moaned and shouted from the pains, persistently requiring aid.

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With the large blood losses the face of wounded pale, lines of face are sharpened. Especially heavy impression produced those wounded the neck division of spinal cord. They are completely immobilized. Respiration is hindered/hampered and wheezing as a result of the incapacity of wounded to frequently expectorate mucus. These wounded suffered from the suffocation. Face and their jaws were cyanotic, voice- soundless, anechoic. Ingestion in many was letuned. About them it is possible to speak that in them live only the eyes.

Already fugitive examination/inspection revealed/detected in more heavily wounded deep disorders of hemodynamics, respiration, thermostatic control. The disorders of hemodynamics were evince<sup>d</sup> by a change in the arterial pressure and heart activity, especially the rhythm of heart contractions.

In many wounded was noted sharp/acute arterial hypotonia. The arterial pressure either completely could not be measured, or it was

very low. It descended as maximum (to 70-60-50) mm, and is sometimes lower), so also minimum pressure (to 50-40 mm); pulse amplitude (pulse pressure) was small, sometimes completely it disappeared. This incidence/drop in the arterial tone noted G. P. Schultze and A. S. Orlovskiy mainly with the wounds of neck and of the upper thoracic division of spinal cord.

So sudden drop of pressure of the blood with these wounds was observed not only during their combination with the heavy wound of the organs/controls of abdominal and thoracic area, but also with the isolated/insulated wounds. The latter fact spoke in favor of the intimate dependence of the disorders of hemodynamics on the damage of the spinal cord.

In the cases lighter wounds arterial pressure during the next 1-2 days gradually was reduced, but in the heavy cases it remained on the low numerals during the weeks.

With the wounds of the average/mean and lower- thoracic division of spine arterial pressure in wounded was or insignificantly lowered/reduced (with the reduction of pulse amplitude), or it was normal, in spite of the sufficiently heavy common clinical picture (pallor, apathy, anechic voice).

In the wounds of the lumbar division of substantial changes in the arterial pressure it was not discovered. But if with the latter/last two localizations of wounds it changed, then only in connection with the simultaneous heavy crushing of the organs/organs of thoracic and abdominal area (the lungs, the liver, kidneys, intestine).

Venous pressure was also lowered, in particular, and in wounded, who entered with the normal arterial pressure.

Frequently were observed changes in the rhythm of heart contractions. With the wounds of the neck and upper- thoracic division of spine usually was noted the delay of heart activity; in separate wounded the pulse dropped to 40 is lower than the shocks per minute. A. S. Orlovskiy observed slowing pulse in the half all those wounded the neck division and only in 9.00/o of those wounded the thoracic division. With the wounds of the remaining divisions of spine the frequency of pulse either was not changed or sometimes considerably it was raised (100-120 shocks per minute).

The observed in wounded slowing of pulse it was not possible to explain by a reduced temperature of body, i.e., by supercooling/chilling. First, were observed the cases of rare pulse at a comparatively little lowered temperature of body (for example,

the pulse of 46 shocks per minute at a temperature of 35.2°).

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In the second place, during the temperature rise of body the frequency of pulse, being increased, nevertheless remained small (for example, at a temperature of 30.5° pulse of 32 shocks per minute; after the heating of wounded at a temperature of 36.3° pulse of 40 shocks per minute). Thirdly, it is known that the wounded have in the shock condition of another etiology, in spite of hypo-therm, nevertheless was not observed the such abrupt decelerations of pulse. All this gave grounds to assume that the delay of heart rhythm was the primary, caused damage of spinal cord.

As far as condition is concerned functional of heart in the sense of its reducibility, then in wounded in the sharp/acute period, besides the deafness of tones, it was impossible to note the phenomena of heart deficiency (absence of shortness of breath, stagnation in the light ones and the liver, edemas, etc.).

Changes in the respiration were revealed/detected in the curtailment of the rhythm of respiration mainly with the high wounds (in some wounded to 12-8-0 per minute) or in the absence of frequency increase, in spite of the sharp/acute vascular deficiency (for



example, 18 respirations at a pressure of blood 90/60; 16-18 respirations at pressure by 80/60, etc.). The simultaneous wound of the lungs, large/coarse hemorrhages into the area of pleura complicated the disorders of respiration, caused by the damage of brain.

For the wounds of spinal cord are characteristic considerable changes in the temperature of body. A sharpest temperature drop was noted with the wounds of the neck and upper- thoracic division of spine. With these wounds were observed the cases, when the temperature of body descended to 32-30°, and sometimes to 25-24°. It descended both axillary and rectal temperature with the amplitude reduction between them.

Attention is drawn to the fact that the temperature sharply fell already into the first hours after wound. In some wounded, in spite of the applied therapeutic measures, temperature returned to the norm extremely slowly. As an example can serve the following observations of G. P. Schultze.

B. I., 43 years. Blind-end fragmentation penetrating wound of spine at the level of the VII neck and I thoracic vertebra and softening spinal cord at this level. Hemorrhage in the shells of spinal cord and the cerebellum; the dynamics of the temperature it is

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shown in Table 10.

The attempts to save wounded were not crowned by success.

Table 10.

(1) Время после ранения	(2) Температура	
	(3) аксиллярная	(4) ректальная
(5) При поступлении . . . . .	23,2°	23,6°
(6) Через 1½ часа после поступления (после грелок, инъекций камфоры) . . . . .	23,0°	23,0°
(7) Через 4 часа после поступления (после вливания горячего физиологического раствора в вену) . . . . .	24,0°	24,6°
(8) Через 5 часов после поступления (после переливания 500 см³ крови) . . . . .	24,0°	24,8°
(9) Через 8 часов после поступления . . . . .	24,2°	24,8°
(10) Через 10 часов после поступления (после повторного вливания физиологического раствора) . . . . .	25,1°	25,8°
(a) Через 13 часов после поступления . . . . .	25,2°	26,0°

Key: (1). Time after wound. (2). Temperature. (3). axillary. (4). rectal. (5). After admission. (6). 1 1/2 Hours after admission (after heaters, injections of camphor). (7). 4 Hours after admission (after infusion of hot physiological solution into vein). (8). 5 Hours after admission (after transfusion 500 cm³ of blood). (9). 8 Hours after admission. (10). 10 Hours after admission (after repeated infusion of physiological solution).

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K. P., 20 years. Fragmentation wound of a upper-thoracic division of spine. Lower flaccid paraplegia. The dynamics of the temperature is shown in Table 11.

Wounded survived the sharp/acute period and it was evacuated into the specialized army hospital.

Considerably more rarely was observed hyperthermy. It was noted mainly with the wounds of a upper-neck division of spinal cord. The author, and also A. S. Orlovskiy observed several patients with an increase in the temperature of body to 39-40°. Attention is drawn to the fact that the patients did not perceive an increase in the temperature and even is not tested/experienced thirst. It is very possible that in the sharp/acute period the hyperthermy occurred more frequently, but in connection with the strained work of the doctors it either was examined/scanned or it was explained incorrectly, for example, by pneumonia.

The pathogenesis of the violations of hemodynamics, respiration and thermostatic control, which attack in the sharp/acute period with the wounds of spinal cord, apparently is complex.

The most probable reason for a sharp/acute drop in the arterial pressure was temporary/time paralysis of cerebrospinal vasomotor centers, caused by the development of shock condition in the division of spinal cord down from the focus, during the simultaneous stopping of admission to these centers of pressure from the cerebral vascular centers, routes/paths from which were damaged in the region of focus.

As a result with the high wounds of spine and spinal cord attacked/advanced the vasodilation in the extensive regions of body, result of which was a drop in the blood pressure.

The basic reason for the delay of heart activity was, apparently paralysis of accelerating nerves of heart. As a result of their paralysis relatively is raised the action of the vagus nerve on the heart. But in the unit of the cases of high wounds, which were being especially escorted/tracked by sub-arachnoidal hemorrhage, it could take place and straight/direct stimulation of rootlets of the vagus nerve or its heart center.

The reasons for the violation of thermostatic control, apparently were following:

- 1) the disconnection of the large sectors of body from under the central action of the heat-control centers;

- 2) the heat loss as a result of a drop in the blood pressure and dilation of capillaries;

- 3) possibly, the insufficient consumption/production/generation of heat (incidence/drop in the metabolic processes, immobility).

The tendency of wounded with the damages of spinal cord toward the cooling is important virtually (heating of wounded in the stages of evacuation). However, applying for the heating of the wounded of heater, it is necessary to remember about the frequently observing in them disorders of sensitivity and the violations of the trophic system of skin and therefore about the possibility of the burns/scalds of skin.

Table 11.

(1) Время после ранения	(2) Температура	
	(3) аксиллярная	(4) ректальная
(5) Через 7 часов после ранения (при поступ- лении) . . . . .	29°	—
(6) Через 24 часа после ранения . . . . .	32°	30°
(7) Через 48 часов после ранения . . . . .	32°	33°

Key: (1). Time after wound. (2). Temperature. (3). axillary. (4). rectal. (5). 7 Hours after wound (after admission). (6). 24 Hours after wound. (7). 48 Hours after wound.

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#### Violations of consciousness.

Those wounded the spine with the damage of spinal cord frequently lost consciousness. The higher division of spine and spinal cord it was affected, the more frequently were observed the disorders of consciousness, and depth and their duration were more considerably. During the heavy damages/defeats of the upper-neck division of spinal cord the violations of consciousness occurred more than in the half cases of -53.0o/o; during the damages/defeats of a lower-neck - into 25.0o/o, and upper- thoracic - into 12.0o/o. With damages of the remaining divisions of spinal cord the disorders of

consciousness were observed as an exception.

The disorders of consciousness became apparent from the short-time blackout, tangled nature, stupefaction to the total loss of consciousness by duration from several minutes to many hours. Rarely were observed hallucinatory and delirious conditions. With the high neck wounds those affected frequently perished, without coming into the consciousness.

By the reason for the violation of consciousness was considered the following: the surprise disorder of the blood supply of brain core as a result of the paresis of bulbar and higher vasomotor centers in connection with the contusion of brain stem as the cerebro-spinal fluid pressure by which at the moment of the penetration of the wounding shell into the area of spinal canal suddenly sharply is raised, and also in connection with jolt and tension of brain stem at the moment of colliding the shell with the spinal cord (especially with the high neck wounds). Some authors explained the loss of consciousness with the wounds of spine by the jolt of brain as a result of head impact against the soil with the incidence/drop in the wounded, and with the wounds by the fragments of artillery shells - action of blast. The disorders of consciousness in these wounded usually were combined with deaf-mutism.



However, important, and possibly, and the basic reason for the loss of consciousness was onset in the cerebral cortex of the spilled inhibition under the effect of the surprise influx to it of the powerful/thick flow of nerve impulses on the afferent paths of spinal cord at the moment of its damage. This explanation will agree well with I. P. Pavlov's exercise about the action on the cerebral cortex of the brain of ultrapowerful stimulations.

During the heavy damages/defeats of spinal cord the wounded on the first hours and day are usually flaccid, apathetic, thinner/less frequent - somewhat euphoric. As a result of the general/common/total suppression of psychics/psyche and frequently observed absence of pains they as did not realize the entire severity of their position/situation. The lines of face are sharpened. Skin integuments and mucosas, especially with the high wounds, are pale and cyanotic.

#### Motor disorders.

Far not in all these wounded the spine were observed the disorders of the functions of spinal cord, including motor. The detailed analysis of the histories of disease/sickness/illness/malady showed that this group of wounded was mixed. Into its composition entered the wounded, who were undergoing detailed neurologic investigation only 1 1/2-2 weeks after the wound when the violations

of the functions of spinal cord and its rootlets underwent reverse development, and wounded those whose violations although occurred, were weakly expressed and rapidly they disappeared. The majority of them was located undergoing medical treatment in the general-surgical institutions.

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In the statistics of specialized neuro-surgical agencies the percentage of those wounded the spine, whose neurologic disorders were absent or they were weakly expressed, was very insignificant (3.0-5.0). Frequency and character/nature of motor disorders in those survived the first several days after wound were found in the dependence on a number of circumstances and, in particular, from the level of the wound of spine.

The analysis of data, given in Table 12, shows that in 30.20/o of persons with the bullet wounds of spine the motor disorders were absent or they were so short-time that up to the moment/torque of neurologic examination/inspection they were expressed very weakly. Most rarely motor disorders were absent in those wounded the thoracic division of spine (22.70/o), more frequent they were not observed in those wounded lumbosacral division (40.00/o). Small number (0.40/o) of spastic paresis with the wounds of a lumbar-sacral division of

spine was explained by the presence of additional stricken areas of higher than a lumbar-sacral thickening, and in the later development periods here of jet arachnoiditis.

Motor disorders were encountered more frequently and they were more heavily with the penetrating wounds of spine. Thus, the full/total/complete violation of the conductivity of spinal cord with the nonpenetrating wounds was observed into 4.50/o, and with penetrating -46.90/o.

With the heavy wounds of spine paralysis appeared, as a rule, instantly. If wounded at the moment of the wound was standing, it usually fell as mowed. In connection with the incidence/drop it frequently obtained the supplementary contusions of body or brain.

The maximum of motor fallouts attack/advance immediately after wound. Their reinforcing during next hours or days was observed rarely. It was conditioned on progressive edema of brain, on growing on epidural either subdural hematoma, displacement of the wounding shell or bone fragments, which penetrated in the area of spinal canal, in connection with the transfer of wounded or the transportation. In the unit of the wounded it was connected with the early suppurative complications.

Table 12. Frequency and character/nature of motor disorders with the bullet wounds of spine and its basic divisions (in the percentages to the volume to a number of wounded).

(1) Характер нарушения	(2) Уровень ранения			
	(3) все отде- ты позво- ночника	(4) шейный	(5) грудной	(6) пояснич- но-крест- цовый
(7) Двигательные расстройства отсутствовали или быстро проходили . . . . .	30,2	39,5	22,7	40,0
(8) Вялый паралич . . . . .	37,5	25,4	57,9	25,9
(9) Спастический паралич . . . . .	8,8	7,7	3,9	—
(10) Вялый парез . . . . .	17,1	16,1	9,3	27,2
(11) Спастический парез . . . . .	2,9	11,3	6,2	0,4
(12) Характер нарушения не указан . . . . .	3,5	—	—	3,5
(13) Итого . . . . .	100,0	100,0	100,0	100,0

Key: (1). Character/nature of violation. (2). Level of wound. (3). all divisions of spine. (4). neck. (5). thoracic. (6). lumbar-sacral. (7). Motor disorders were absent or rapidly they passed. (8). Flaccid paralysis. (9). Spastic paralysis. (10). Flaccid paresis. (11). Spastic paresis. (12). Character/nature violation is not shown. (13). Altogether.

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The surprise and sharp stimulation of motor guides and reflector centers of spinal cord at the moment of wound could, apparently lead to the sharp contraction/aberration of the muscular groups which subsequently were paralyzed. As a result of extremity and body for the instant strongly they were strained and accepted abnormal

positions/situations. So, some wounded the thoracic division of spine declared, what do they have "body and feet to the instant it brought together by wheel", "feet were strained, as the strings", wounded into the neck division they indicated that "the hands involuntary rose and then they fell, as lashes", "hands it accurately extended and threw for the shoulders".

All neuropathologists noted that in the suppressing number of wounded the motor disorders initially had bilateral and uniform character/nature. Thinner/less frequent already a the nearest hours and day after wound they were weaker expressed on one side. Finally, in the exclusively rare cases with the wounds of spinal cord by the fine/small mine fragments which, as if cutting brain, did not deposit on the remaining part of it diameter of considerable contusion, motor fallouts from the first hours after wound were limited only to the one half body. During the damages/defeats of horse tail the asymmetry of motor fallouts was observed more frequently and protruded earlier than during the damage/defeat of the very substance of brain.

Rates/tempo and limits of the reverse development of paralyses first of all were determined by the severity of the damage of spinal cord. With the light jolts of spinal cord the movements completely were reduced during several hours or days. During the more intense damages of spinal cord the reduction of motor violations began after

3-4 weeks and was involved/tightened to many months and years. Even after 1 1/2-2-3-year after wound motor violations continued to be reduced.

Experiment/experience showed that the reduction of the reversible changes in the substance of spinal cord and in the rootlets of horse tail in the sharp/acute and early period was detained or completely stopped due to the pressure on them of foreign bodies (wounding shells, bone fragments), hematoma; in the intermediate and late period - by the callus, epidural scars, arachnoidal cysts and by pia- arachnoidal adhesions.

The reduction of motor disorders in the unit of the wounded not only stopped, but even it was changed by the deterioration which was developed first slowly, then subacute or is sharp. Sharp/acute deterioration was noted with hematomas, suppurative myelitides, epidural, subdural and intra-medullary abscesses and more frequently it was observed in the early period. In the intermediate and late period the deterioration was noted more rarely. It was usually connected with the development of pachymeningitis, progressive arachnoiditis, callus and flowed/occurred/lasted more slowly; subacute deterioration in these periods was observed with the late suppurative pachymeningitis. Sometimes was noted the deterioration in connection with any general/common/total infection, for example, by

influenza, and also with the physical overvoltage, the repeated injury of spine, frequently insignificant and the like.

The level of the original violation of motor functions usually descended, besides sometimes it is very considerable. The latter was noted in particular during the damages/defeats of a upper-thoracic division of spinal cord and horse tail. Thus, during the damages/defeats of a third-fifth thoracic segment initially frequently appeared paralysis or deep paresis of upper extremities, subsequently completely disappeared.

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In such cases the damage/defeat of upper extremities was conditioned, apparently on the jolt of neck thickening or on the spread to it of jet edema from the zone of the damage of spinal cord, and also on the time/temporary disorganization of the sympathetic innervation of the upper extremities whose trophic and vasomotor centers were laid, as is known, in upper- thoracic segments.

The especially considerable noncoincidence of the levels of initial and final motor disorders were observed during the damages/defeats of horse tail. For example, during the damages/defeats of horse tail at the level of the V lumbar or I

sacral vertebra at first usually was observed paralysis of lower extremities, whereas including proximal divisions their, residual conditions they were limited only to cut or paralysis of foot. Such extensive initial motor fallouts in this genus the cases depended on the contusion of epiconus of the liquor wave, which appeared at the moment of the penetration of combat shell into the area of spinal canal, and also from the surprise tension of rootlets of horse tail at the moment of colliding with them the combat shell. The mechanism of this distant activity of the wounding shell will be examined below.

In those wounded the spine, which simultaneously underwent the action of blast, sometimes was noted muscular weakness in the divisions of body, turned to the point of impact. It was connected with the contusion of body with the blast, acting like the shock by wide dull object/subject.

Against the background of the motor violations, caused by the damage/defeat of spinal cord and its rootlets, at first after wound can be laminated the overall muscular weakness, connected with the general/common/total shock, the blood loss, and sometimes of damages/defeats the XI and XII thoracic and first lumbar vertebrae - with the damage of the adrenal glands.



The experiment/experience of the Great Patriotic War showed that during the estimation of motor violations it is necessary to consider the possibility of their psychogenic (hysterical) pathogenesis. However, on the field of battle and in the foremost stages of this type the cases were observed exclusively rarely. But within the later periods in separate wounded, during the determination in the hospitals of front, sometimes were noted hysterical layerings against the background of the organically caused paresis.

Sensitive disorders.

Sensitive disorders were observed just as frequently as motor (Table 13).

The analysis of given data shows that any considerable sensitive violations in the early period were absent in 30.30/o of all wounded. The total loss of sensitivity occurred in 39.80/o; especially frequently it was noted with the wounds of the thoracic division of spine (58.10/o). The maximum of sensitive violations as motor, was established/installed usually immediately after wound. However, their build-up/growth subsequently, sometimes after temporary/time improvement, was conditioned rate/tempo on reasons, as motor.

At the moment of wound those affected usually tested/experienced

the perception of the dull smack into the back and frequently the breakaway of the underlying division of body and extremities, and with the wounds of the neck division of spine - the breakaway of head. The perception of the breakaway of the unit of the body was sometimes so/such real and frightening, that, seeing their paralyzed extremities were not torn off, wounded requested their comrades to confirm this.

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Many wounded at the moment of wound tested/experienced the perception of the passage of electric current along spine and lower extremities, are thinner/less frequent temperature paresthesias: the paralyzed unit of the body "it poured by cold", by "fever".

Immediately after wound pains during the rough damages of spinal cord usually were absent or they were insignificant. More frequent they were perceived only in the region of wound. However, during the damages/defects, which caused only the the partial violation of the conductivity of the conductivity of spinal cord and which were being escorted/tracked by sub-arachnoidal hemorrhages or straight/direct stimulation of rootlets by foreign bodies, the pains from the first hours achieved very large intensity. Are especially intense were intense pains during the partial damages of horse tail. Therefore the presence of pains immediately after wound or their appearance during the nearest hours or the days was considered by neuropathologists as the favorable symptom, which speaks about a comparatively moderate/mild damage of spinal cord and horse tail.

The absence of pains at first glance seems paradoxical, especially if, together with the spinal cord, are damaged rootlets. The explanation to this special feature/peculiarity of the heavy bullet damages/defeats of brain must be searched for in the violation of conductivity on the sensitive spinal-thalamic route/path in the division of spinal cord, arranged/located higher than the place of the entrance into it of the damaged posterior rootlets (Fig. 43). The violation of conducting impulses/momenta/pulses in the overlying division of spinal cord was caused by cerebrospinal shock, onset here of additional foci, by spread to it of reactive edema from the zone of maximum damage.

The aforesaid illustrates the given scheme (Fig. 43). Impulses/momenta/pulses on rootlets a cannot be spread to the cortex as a result of the violation of the conductivity of their central continuations in the region of the stricken area of spinal cord (A); whereas on the rootlets b, which enters into the spinal cord is higher than the stricken area, as a result of its damage but from the overlying rootlets c - as a result of the shock condition of this division of spinal cord, presence here of the additional foci of damage/defeat or reactive edema.

Table 13. Frequency and character/nature of the violations of sensitivity in the early period with the bullet wounds of spine and its basic divisions (in the percentages to a total number of casualties).

(1) Характер нарушения	(2) Все отделы позвоночника	(3) Отдел		
		(4) шейный	(5) грудной	(6) пояснично-крестцовый
(7) Чувствительные расстройства отсутствовали или быстро проходили . . . . .	30,3	34,0	21,9	36,6
(8) Анестезия . . . . .	39,8	27,9	53,1	28,3
(9) Гипестезия . . . . .	22,5	25,4	14,5	29,0
(10) Гиперестезия . . . . .	3,4	6,1	2,2	2,7
(11) Каузалгия . . . . .	0,2	0,2	0,2	0,2
(12) Диссоциированный тип . . . . .	0,6	1,1	0,5	0,3
(13) Сочетание . . . . .	3,2	5,3	2,6	2,9
(14) Итого . . . . .	100,0	100,0	100,0	100,0

Key: (1). Character/nature of violation. (2). All divisions of spine. (3). Division. (4). neck. (5). thoracic. (6). lumbar-sacral. (7). Sensitive disorders were absent or rapidly they passed. (8). Anesthesia. (9). Hypesthesia. (10). Hyperesthesia. (11). Causalgia. (12). Dissociated type. (13). Combination.

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With the full/total/complete anatomical interruption of spinal cord, if the rootlets, which enter in the spinal cord above focus of damage, were not involved from the intergrowth between the shells or

into the scars, pains were absent also subsequently. During the partial damages of spinal cord in proportion to the reduction of its conductivity appeared the so-called conductor pains, which frequently achieved considerable force. Usually they are they were the more intense, the weaker was disrupted the conductivity of spinal cord and the sharper were irritated the sensitive rootlets.

In the sharp/acute and early period damage of rootlets was most frequently conditioned on compression by their foreign bodies, stuck out into the lumen of spinal canal by the substance of interspinal disks, by the issuing from into the sub-arachnoidal space blood, their implication in the sharp/acute inflammatory processes in the shells and in the tissues of epidural space. In the later periods, besides the foreign bodies, if they were not removed, the most frequent reasons for the stimulation of rootlets they were: chronic pachymeningitis, arachnoiditis, callus, osteomyelitis, strains of vertebrae, traumatic spondylosis.

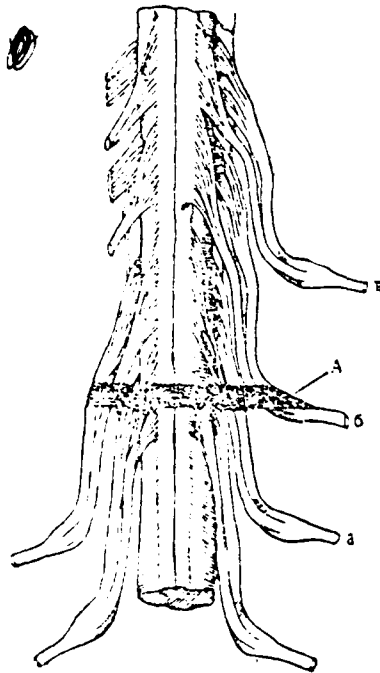


Fig. 43.

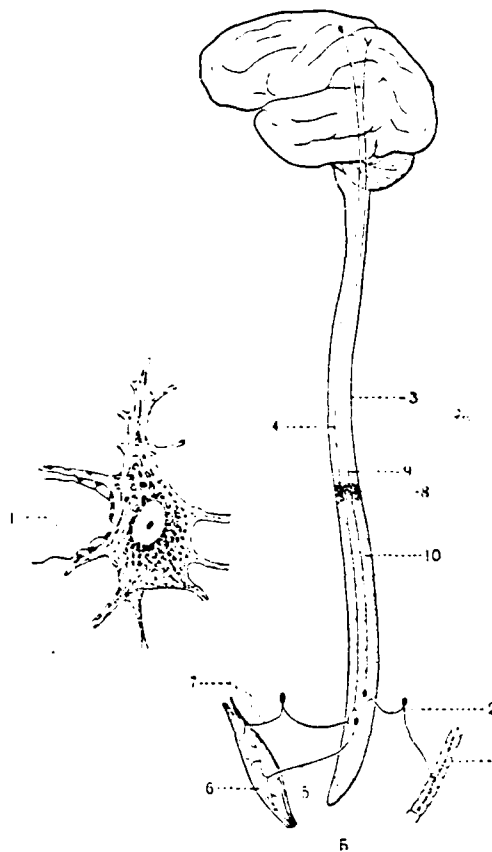


Fig. 44.

Fig. 43. Scheme of violation of conductivity with wound of spinal cord. Explanation in the text.

Fig. 44. Motor call of front/leading crescent of spinal cord. A - the scheme of the junction of impulse/momentum/pulse from one neuron to another. 1 - nerve ends with their synapses. B - scheme of the violation of the conductivity of spinal cord with the bullet wound. 1

- cortex; 2 - sensitive cell; 3 - sensitive route/path from the spinal cord to the cerebral cortex; 4 - central motor neuron; 5 - peripheral motor neuron; 6 - transversostriated muscle; 7 - sensitive neuron; 8 - focus of the damage of spinal cord; 9 - zone cerebrospinal shock above the focus; 10 - zone of cerebrospinal shock under the focus.

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All authors underscored the multifeature character/nature of pains - dull, that ache, shooting, that pull, that drill, compressing, with the admixture/impurity of the perception of burning, cold, etc. Being spread on the course of rootlets, they had in the region of body the encircling character/nature, and on the extremities - longitudinal. Against the background of permanent pains in the unit of the casualties were observed their paroxysmal reinforcing, which frequently achieved large force. With damages of horse tail of one of the reasons paroxysmal reinforcing of pains was the overfilling of urinary/urine bladder with urine, and by straight/direct intestine-feces. Pains frequently were amplified with the onset of complications in the internal organs/controls. Evidently, stimulations, taking place on the sympathetic filaments to the spinal cord from the bladder, the intestines and other internal organs/controls, excitant of its pain-perceiving and pain-conducting



apparatuses.

In the paralyzed extremities, especially in the heels and the feet, some casualties tested/experienced the extremely painful perceptions of "springing-away and inflation" or strong "compression". A. I. Geymanovich explained by their transient paresis or by spasm of foot arteries.

In the intermediate and late period, especially during the damages/defects of horse tail, pain they sometimes acquired the expressed causalgic character/nature. Interventions on the horse tail, which consisted of the liberation/excretion of rootlets from the arachnoidal intergrowth, did not always give positive effect. In a number of cases were required supplementary interventions on the ganglia/nodes of frontier sympathetic shafts, which led, as a rule, to the elimination of causalgic component in the painful radicular syndrome. In these cases causalgic pains, apparently were conditioned on the strong stimulation of the painful vegetative filaments, which pass in the composition of rootlets. Very intense pains, although it is rare, were observed with multiple failure of sympathetic ganglia, connective branches and frontier trunks. For these pains, especially during the damage of ganglia/nodes, are characteristic the diffusivity of dissemination, the admixture/impurity of the perception of burning, "combustion", heat or cold.

During the damages of the upper jugular gland of pain usually covered the similar/analogous halves head and neck; during the damage/defeat of star-shaped ganglion-similar/analogous hand and half chest, approximately/exemplarily to the VI-VII edge/fin; during the damage/defeat of lumbar ganglia/nodes they applied to the appropriate foot and the lower divisions of stomach. Against the background of dull, the more or less permanent pain, which occupied a comparatively small region of body, were observed the attacks/seizures/paroxysms sharp reinforcing of pain with the simultaneous expansion, sometimes very considerable, the regions of its dissemination. Sometimes vegetative pains acquired the fluctuating character/nature or would be escorted/tracked by the perception as if of swelling and springing-away of the sector of the body, encompassed by them. These pains frequently were amplified under the effect of the local thermal procedures, the emotions.

Vegetative pains were characterized by perseverance, little yielding to the activity of conventional analgesic means. In the mild cases they sometimes were cured by repeated novocaine blockades, in the firm ones - only after interventions on the frontier sympathetic shaft.

Some casualties with the partial violation of the conductivity of spinal cord at first after wound perceived the paralyzed division of body as something alien, with it not belonging. During the damage/defeat of the neck division occasionally were observed the violations of the scheme of body. More frequent matter went about the apparent change in the position/situation of the paralyzed extremities. For example, in casualty appeared perception, that his paralyzed foot was bent in the knee and hip joint, while in actuality it was completely driven away, and the like. Sometimes appeared the more complex forms of the violation of the scheme of body. Thus, with the high neck wounds, bringing about spinal hemiplegia or upper spastic diplegia, separate casualties in the early period for a certain period of time tested/experienced the perception of the presence in them of additional (third) hand.

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In the overwhelming majority of the cases into the first they are frequent and days after wound sensitivity on both sides of body was disturbed evenly, but during the incomplete cross damages of spinal cord it one way or another already within the next few days was reduced on one half body. Upon the full/total/complete transverse contaminations of spinal cord and horse tail the sensitivity remained stably lost.

During the temporary/time, but deep cross violation of the conductivity of spinal cord sensitive disorders in the sharp/acute stage were usually expressed weaker than motor. So, with the full/total/complete paraplegia casualty frequently was capable to perceive such rough stimulations as deep injections, energetic compression of fingers/pins, feet, gastrocnemius muscles.

In the sharp/acute stage most massive were usually conductor violations. In the divisions of body, innervated by the sector of spinal cord down from the stricken area, the sensitivity either completely was lost or deeply it was disturbed.

The segmental violations of sensitivity, caused by the damage of the gray substance of brain or by hemorrhage in it, initially usually were shaded as a result of the overlap by their conductor ones. Exception were only the cases more or less isolated/insulated tubular hematomyelia, which was not being escorted/tracked by the damage of lateral or posterior columns. The segmental violations of sensitivity came forward against the background of conductor ones and when hemorrhage in the gray substance in the form of the gradually narrowed cone considerably heaved above the level of the basic focus of damage.

In the the sharp/acute period even upon the full/total/complete transverse contaminations of spinal cord upper boundary of the violation of sensitivity never was distinct and sharp. Above the level from which began the loss of sensitivity, usually was arranged/located the zone of gradually growing on hypesthesia and hypalgesia. The sizes/dimensions of this zone were sometimes very considerable. Sometimes it captured 3-6 and more than segments. The instructions of some authors to the fact that in the early period above the zone of loss of sensitivity frequently there is the zone of hyperalgesia, did not find confirmation in observations of others. But subsequently in connection with the disappearance of shock the zone of hyperalgesia frequently appeared in the division of the spinal cord above the basic focus. The same was noted also with the development here of arachnoiditis.

sensitive disorders during the rough damage of the posterior columns of spinal cord and relative state of preservation of the conductivity of lateral ones usually acquired the protopastic character/nature: the compression, for example, of the toes of foot or fold of skin was received as extremely morbid, unpleasant, spilled, slowly disappearing, frequently with the hue of burning, the perception of combustion. Skin hyperesthesia also hyperalgesia in

these cases they frequently acquired the sharply pronounced character/nature: not only injections, but even touch of clothing, sheet was received by casualties as very unpleasant and morbid.

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Experiment/experience showed that upon the examination/inspection of the sensitivity, in particular, painful, it is necessary to consider the deceleration of conducting the caused impulse/momentum/pulse and in particular with the law of the summation of excitations. With gross increase in the threshold of the excitability of sensitive terminations in this region of body single injection can not be perceived by casualty, but several after pricking, plotted/applied through the short gaps/intervals in the same sector and with the same intensity, they are distinctly by it perceived. On this it is important to remember in order not to recognize the presence of the complete loss of the conductivity of spinal cord when in actuality there is its only gross weakening. Frequently were encountered erroneous conclusions about the presence in the wounded full/total/complete "interruption" of spinal cord only because the neuropathologist disregarded/neglected the law of the summation of stimulations.

During the light damages of spinal cord the reduction of

sensitive disorders began already into the first hours after the wound: with heavy- this moment/torque was moved aside to the weeks. Upon the partial transverse contaminations of spinal cord the reduction of sensitivity occurred due to the reduction both of conductor and segmental violations. In this case frequently occurred a considerable decrease in the upper level of the disorder of sensitivity. Upon the full/total/complete transverse contamination of spinal cord the sensitivity was reduced only due to certain reduction in its upper boundary. Suprafocal aypesthesia also hypalgesia disappeared, and gradually was drawn the level of the stable loss of sensitivity.

The begun reduction of sensitivity sometimes stopped and was changed by deterioration under the effect of the same reasons as motor disorders.

The limits of the reduction of sensitive violations generally and the separate forms/species of it in particular completely were determined by the severity of the damage of spinal cord and by the localization of focus with respect to its cross section. With the jolt of spinal cord the sensitivity was reduced completely during the next hours and the days. During the partial damages of the diameter of spinal cord, depending on localization of focus, some forms/species of sensitivity were reduced in full or in part, and

others - remained stably lost. As a result in the residual conditions appeared the very peculiar combinations of the sensitive violations with which it is not necessary to meddle in peacetime. In the heavy cases the process of reduction of sensitivity lasted many months and even years.

In order rapidly to be oriented in the condition of sensitivity, in particular from the point of view of the estimation of the severity of the cross damage/defeat of spinal cord, under conditions for work on PMP, in MSB or PPG, it was sufficiently energetically compress fingers/pins foot, feet themselves or gastrocnemius muscles. With the state of preservation in the wounded perception of the compression of the units of the body indicated, and that it is more the perception of pain, at least and dull, was excluded not only anatomical, but also functional breaks of spinal cord. For the full/total/complete representation about degree and character of the violations of sensitivity was required the careful investigation all of its forms/species. In the opinion of neuropathologists' majority, for the judgment about the severity of the damage of spinal cord the investigation of the sensitive function had larger value than motor one.



In neuropathic individuals sometimes were noted the disorders of the sensitivity of hysterical character/nature.

#### Reflexes.

Tendinous, periosteal and skin reflexes in the sharp/acute and early period, even during a comparatively moderate/mild damage of spinal cord, usually proved to be lost; rarely they were weakened, and it is still less frequent - they were increased. The latter was observed sometimes of the wound of brain by the fine/small metallic fragments which with the wound of spinal cord deposited weak contusions on those being adjacent to it to units.

The speed of the reduction of reflexes was determined by the severity of the damage of spinal cord.

During the rough cross damages of spinal cord the reflexes of the paralyzed divisions of body usually began to be reduced only through several weeks after wound. Especially late were reduced reflexes in the cases of the complete destruction of spinal cord. Bastian-Bruns's law - tendinous-periosteal reflexes with the full/total/complete anatomical interruptions of spinal cord never are reduced - was shaken already in the first world war. On the basis of the experiment/experience of the Great Patriotic War it is

possible to consider finally disproved. Evidently, and Bastian, and Bruns (Bastian, Bruns) insufficiently long observed their patients. In such cases for example, the damages/defeats of the thoracic division of the spinal cord when reflexes on the lower extremities were not reduced also in 2-3 months, the reason for this were gross morphological changes in the division of spinal cord down from the basic stricken area.

Pathological foot reflexes (Babinski Rossolimo, Zhukovskiy, Oppengeym, etc.), similar to tendinous ones during any heavy damages/defeats of spinal cord, during the first days and in the weeks after wound were absent. They appeared those later, the heavier there was the damage of brain. Upon the full/total/complete transverse contaminations of spinal cord of higher than a lumbar-sacral thickening they frequently appeared only later many weeks.

The speed of the reduction of tendinous-periosteal reflexes and appearance of pathological ones depended not only on the severity of the damage of spinal cord, but also on the localization of damage. The higher was damaged spinal cord, then with the same degree of its cross damage/defeat, more rapidly appeared reflexes, and flaccid paralysis or paresis converted/transferred into the spastic. Thus, with the wounds of the neck division of spine the junction of

paralysis and paresis of lower extremities into the spastic was observed into 19.00/o of all wounds of spine, and with the wounds of thoracic division - into 10.10/o.

After the first world war relative to the sequence of the appearance of the initially lost reflexes were voiced different opinions. Some authors asserted that first of all are reduced the tendinous reflexes, others, that first of all appear pathological. Observations in the Great Patriotic War showed that there are no specific laws in this respect. In some casualties first of all were reduced tendinous reflexes, while in others - first appeared that or another pathological reflex. Comparatively early was reduced bottom reflex and it is especially rapid cremaster.

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The condition of the reflexes of the paralyzed extremities in the sharp/acute period of the bullet damage/defeat of spinal cord had very important forecasting importance. The more rapidly were reduced the tendinous-periosteal reflexes or appeared pathological reflexes, the weaker there was the damage of spinal cord. The state of preservation of tendinous reflexes or the appearance of pathological ones already during the first hours and the days after wound they spoke about the relatively insignificant damage of spinal cord.

### Tone of the paralyzed muscles.

The tone of the paralyzed muscles weakened or completely was lost immediately after wound. As a result of atony paralyzed extremities were represented as by those split, abnormally wide ones. Usually well seen configuration of muscles disappeared. The paralyzed extremities could be bent and driven away in the joints more than in the norm.

Since the tone of muscles - the manifestation first of all of the reflector activity of spinal cord, its reduction occurred usually in parallel to the reduction of tendinous-periosteal and skin reflexes. By all neuropathologists prolonged deep atony was considered as prognostically very unfavorable symptom. Its presence during the high damages/defeats of spinal cord was estimated as indication that in the divisions down from the basic focus are additional foci or deep disorders of roof and liquor circulations.

With the high localization of the damage/defeat of spinal cord in proportion to the reduction of reflexes and increase the tone of muscles in the lower extremities usually appeared massive lengthening-shortening reflexes (shielding movements of the previous

authors). However, they rarely achieved such degrees as, for example, during myelites or compressions of spinal cord by neoplasm. In this case they appeared not only as a result of such external stimulations as injection, but also under effect of the excitations, which flow to the spinal cord from the internal organs/controls, in particular from the bladder. The overfilling of the bladder in some casualties caused not only reinforcing spasticity of lower extremities, but also appearance of involuntary movements, which were being evinced by their rhythmic reduction. Wounded usually they themselves noticed connection/communication between these involuntary appearing spasms of feet and overfilling of the bladder by urine considered them as the signal of the need of releasing the bladder actively or by catheterization. Frequently following a similar attack/seizure/paroxysm of spasms followed the involuntary departure/separation of urine. The latter in particular frequently was observed during the high damages/defeats of spinal cord during which surprise toning stress appeared also in abdominal muscles. The caused by it the interabdominal pressure increase contributed to the passive emptying of the bladder. Sometimes the toning stress/voltage of the musculature of feet was changed by convulsive twitchings or their large/coarse vibration (old authors' spinal epilepsy).

If painful sensitivity at least partially was retained, the attacks/seizures/paroxysms of spasms caused the sharp pains, which

forced casualties heavily to suffer. The spasms of abdominal muscles in these cases were escorted/tracked by the perception of strong compression and morbid encircling around the stomach. The latter sometimes erroneously was distinguished as radicular pain.

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Were observed the more complex reflector movements of the paralyzed extremities, for example, the movements, which reproduced as if report/event of walking, i.e., alternating flexure and unbending of extremities in that sequence, as it takes place with the walking. Usually each extremity accomplished several movements whose volume gradually decreased.

Cerebro-spinal fluid.

Qualitative changes in the cerebro-spinal fluid were frequent and multifeature. They were determined by severity and character/nature of damage of spinal cord, its shells and vessels, and also by condition of the cross-country ability of sub-arachnoidal space and by degree of the infection of shells and depended also on the period, which passed from the moment/torque of wound.

In the first 1-1 1/2 weeks after wound in the absence of

meningitis or abundant sub-arachnoidal hemorrhage the pressure of cerebro-spinal fluid was usually moderately increased or normal. With the penetrating wounds of spine approximately/exemplarily in third of cases it was reduced. Basic reason for decreasing in in the pressure authors' majority perceived in the permanent escape of fluid/liquid into the epidural space through the available defect in the solid cerebral shell. In the later periods, with isolation of sub-arachnoidal space from the defect, the pressure was more frequently moderately increased. The elevated pressure of cerebro-spinal fluid in many casualties was held very for a long time. Kh. M. Freydin and Kirichenko, that stippled in time from 2 weeks to year are later from the moment/torque of wound, established/installed increase pressures in 74.00/o of casualties. The majority of those stippled had severe damage of spinal cord.

The level of cerebro-spinal fluid in the manometer, connected with the puncture needle in the norm detects the oscillations/vibrations, which coincide with the pulse and the respiration. Knauer on the basis of observations, which relate to the first world war, saw in the absence of these pulse and respiratory oscillations the proof of the presence of defect in the solid cerebral shell. Special investigations showed that the absence of the pulse and respiratory oscillations of the level of fluid/liquid in the manometer by no means it is not possible to consider the reliable

symptom of the violation of the integrity of solid cerebral shell (I. Ya. Razdol'skiy). The disappearance of these oscillations/vibrations was observed not only with the defect of shell, but also with the blockade of sub-arachnoidal space, especially during its low disposition, without the least traces of the violation of the integrity of shell.

In the sharp/acute period the color of cerebro-spinal fluid was frequently changed due to the admixture/impurity of the blood. This, in particular, had the place in the cases of heavy wounds and crushing of spinal cord, and also damages of radicular and tunicary vessels. With the abundant outflows of the blood the cerebro-spinal fluid during the first days after wound took the color and the form of meat swill; subsequently, in proportion to hemolysis, it acquired different stain/staining - from the oncorhynchus nerka to hardly yellow.

Through 1 1/2-2 weeks the color of fluid/liquid usually became normal. Exception were the cases of the extensive sub-arachnoidal hemorrhages when the yellow and yellowish stain/staining of fluid/liquid (xanthochromia) was retained to 3-3 1/2 weeks.

With the brain concussion, reactive edema, comparatively not heavy contusions of spinal cord, or with the wounds of brain by



fine/small metallic and bone fragments, if there is no admixture/impurity of the blood, the transparency of cerebro-spinal fluid did not change. With rough crushings, breaks and wounds of brain its transparency was decreased not only due to the admixture/impurity in it of the blood, but also as a result of an increase in it of the cellular elements/cells, or the presence of the fission products of nerve tissue. Especially with the breaks and rough crushing of brain during the first several days by the already naked eye it was possible to see in the cerebro-spinal fluid of the drop of myeline, and sometimes also the smallest scraps of cerebral tissue. The latter could be discovered also in the sediment after the centrifugation of fluid/liquid.

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Through 1 1/2-2 weeks the cerebro-spinal fluid, if was not connected meningitis, usually became transparent/hyaline.

Considerable admixture/impurity to the cerebro-spinal fluid of blood - symptom, testifying to the serious damage of brain. However, the experiment/experience of the elapsing war showed that it cannot be agreed with the assertion of Schulze and Haneken which the admixture/impurity of blood always indicates very rough destruction of spinal cord and therefore surgical intervention in this genus the

cases aimlessly. The blood can enter cerebro-spinal fluid not only from the vessels of damaged brain, but also from the vessels of its shells and rootlets, the substance of spinal cord can not be substantially damaged. This fact was repeatedly underscored by Soviet neuropathologists and neurosurgeons. As the symptom of the rough damage of spinal cord incomparably larger value has an admixture/impurity to the cerebro-spinal fluid of the drops of myeline and in particular the presence in it of the scraps of cerebral tissue.

An increase of the number of cellular elements/cells in the cerebro-spinal fluid, pleocytosis, in the sharp/acute period of the wound of brain are almost rule/handspike. In the uncomplicated cases it fluctuated in the limits of several tens (M. B. Zvinyatskiy et al.). During the first days predominate the neutrophils, into further-lymphocytes. Were noted glial cells (mark and myelophages) and histiocytes.

In the absence of suppurative complications from the side of shells and substance of spinal cord a number of regular/prescribed elements/cells gradually returned to the norm. However, frequently it remained increased during many weeks. In the intermediate and late period Kh. M. Freydin et al. they found increases in cytolysis in 28.00/o of casualties. Cytolysis, and also content of protein in the

cerebro-spinal fluid they were usually the higher, the lower the focus of damage. This especially relates to the damages/defeats of horse tail, during which the survival of casualties with the heavy forms of wounds was observed relatively more frequently, and reactive arachnoiditis usually was expressed sharper than during the damages of the substance of spinal cord.

With the onset of suppurative complications the soft cerebral shells or in the substance of brain the fluid/liquid acquired suppurative character/nature.

In the sharp/acute period an increase in the content of protein was noted almost as a rule. It is it was the higher, the rougher there was the damage of spinal cord and the sharper there was the inflammatory reaction of cerebral shells. Subsequently, in the cases of the normal cross-country ability of sub-arachnoidal space, it gradually returned to the normal numerals. This process proceeded very slowly. The moderate increase in the quantity of protein was detected frequently later several weeks after wound. In the presence of blockade of subarachnoidal space a quantity of protein sometimes achieved the very high numerals (6-12‰ with the norm in 0.3‰). It is it was usually the higher, the more prolonged there was the blockade. Sometimes a quantity of protein was so/such considerable, that the released into the test tube cerebro-spinal fluid through

several minutes was coagulated like by jelly.

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The experience of the neuropathologists showed that the investigation of cerebro-spinal fluid in the sharp/acute and early period of the bullet wound of spinal cord has very important value for the judgment about character/nature and severity of an injury of brain, and also of wasps of the degree of the infection of sub-arachnoidal space and presence or absence of its blockade. Puncture it is necessary to produce even under such conditions when its microscopic and bacteriological examination they are not attained. Already color and degree of the transparency of cerebro-spinal fluid, and also change in the pressure in proportion to its extraction gave quite valuable data for deciding/solving the mentioned above questions. Only with the aid of the puncture it was possible to in proper time recognize the onset of suppurative complications, in particular restricted suppurative meningitis, and also compression of spinal cord by foreign bodies.

In the later periods the puncture is necessary, since only it can exclude the compression of spinal cord or rootlets of horse tail by epidural scars, arachnoidal intergrowth, calluses.

But however is important investigation of cerebro-spinal fluid, from it one should restrain in the cases of the extensive infected wounds or bedsores in the lumbar region in view of the danger of the recording of infection by the needle of substances sub-arachnoidal space. In the sharp/acute period from it one should abstain in casualties with the phenomena of general/common/total shock.

With extensive adhesive arachnoidites, and also fibrous pachymeningitis in the region of horse tail lumbar puncture frequently proved to be "dry". As a result of closing/healing of sub-arachnoidal space (with arachnoidites) or compression its (with the pachymeningitis) to extract fluid/liquid even with the repeated punctures it was impossible. With the confidence in the penetration by the needle through the solid cerebral shell "dry" puncture with the large fraction/portion of likelihood was considered as indication of these complications.

Damage of the function of pelvic organs/controls.

The disorders of the functions of pelvic organs/controls in the sharp/acute period were observed into 54.90/o of all cases of the bullet wounds of spine. They had very diverse character/nature.

The disorders of urination were observed more frequently than

defecation, and had a great effect on issues wounds.

Disorders of the functions of pelvic organs/controls in the early period of the bullet wounds of spine in spinal cord (in the percentages).

The disorders of the functions of pelvic organs/controls were absent or rapidly they passed ... 45.1.

Delay of urine ... 13.9.

Delay of urine and feces ... 32.8.

Irretention of urine ... 5.0.

Irretention of urine and feces ... 0.4.

Irretention of feces ... 2.0.

Paradoxical irretention of urine ... 0.7.

Other forms/species of disorders ... 0.1. = 100.

From the given numerals it is evident that most frequently it was observed to the delay of urine (47.40/o), moreover into 0.70/o it had a character/nature of paradoxical irretention.

The numerals of the disorders of the function of pelvic organs/controls in the statistical materials, published by the individual authors based on materials of personal observations, are considerably above. Thus, G. D. Aronovich (GVF) observed the violation of urination in 69.30/o of casualties, N. N. Ovchininskiy - in 71.80/o (evacuation hospitals of front and armies), G. P. Korniyanskiy - approximately 80.00/o (evacuation hospitals of front), R. S. Orlov - almost in all wounded those finding under its observation. The higher numerals of the disorders of urination in mentioned authors' materials are explained by the fact that the authors worked in the specialized agencies, where entered casualties predominantly with the heavy damages/defeats of spine and spinal cord.

Initially, independent of the level of damage of spine, appeared the delay of urine. But sometimes of the damages/defeats of brain at the level of the second-fourth lumbar segment from the first days after wound attacked/advanced the irretention of urine.

The small unit of the casualties, especially into a lower-thoracic division of spine, indicated that immediately after wound, it is thinner/less frequent after 1-1 1/2 minutes, in them was observed the involuntary departure/separation of urine and feces. Subsequently in these cases was developed their delay. Evidently, the involuntary emptying of bladder and rectum attacked/advanced as a result of the surprise stimulation of their motor cerebrospinal centers.

Frequency and staying power/persistency of the disorders of urination in those survived the first hours after wound were found in the dependence on the level of the damage/defeat of spine. Thus, during the damages/defeats of the neck division of spine the disorders of urination occurred in 24.30/o, those of thoracic division - into 64.40/o, lumbar- sacral - into 75o/o.

During the damages/defeats of the neck and thoracic division of spinal cord are damaged only the ways of active control of urination. During the damages/defeats of a lumbar-sacral thickening, besides this, is damaged its reflector apparatus; finally, during the damages/defeats of horse tail is damaged only reflector apparatus. Therefore during the bullet damages/defeats of a lower-thoracic and



lumbar- sacral division the violations of urination appeared during the lighter damages and, as a rule, they were more stable. Besides this, in those transferred the wound of the neck division of spine heavy cerebrospinal phenomena were observed considerably thinner/less frequent than with the wounds of thoracic division.

G. D. Aronovich, who observed in assense of casualties with the heavy forms of the bullet damages/defeats of spinal cord, within the next few days after wounds established/installed with the wounded of neck division the delay of urine in 18.2% with the wounds of thoracic division - in 80%, with the wounds of a lumbar-sacral division in 86.2%, during the damages of cone and horse tail in 85.4%. The loss of urge for the urination he noted in 36.0% of casualties.

During the high damages/defeats (Fig. 45.I) initially, as a rule, suffered not only active control of the report/event of urination, but also reflector emptying of the bladder. As a result of the interruption of sensitive routes/paths casualties did not perceive urges for the urination, and as a result of the interruption of crust motor routes/paths to the external sphincter they could not actively reduce the latter and thereby prevented the involuntary liberation/excretion of urine from the bladder.

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The disorder of the reflector emptying of the bladder was conditioned on paresis or paralysis of detrusor as a result of the cerebrospinal shock or the onset of the supplementary foci of damage/defeat in the sacral segments of spinal cord. As a result at first appeared the full/total/complete delay of urine. If the bladder was not freed/released artificially, then the accumulated in it urine overcame resistance of internal sphincter and drop by drop or by small portions it was drawn through into the urinating canal (paradoxical irretention of urine).

The higher was localization of the damage/defeat of spinal cord, the more rapidly passed the shock paresis of detrusor and the earlier was reduced the automatic emptying of the bladder. The report/event of urination began spontaneously, as soon as in the bladder it was accumulated by 150-200 cm<sup>3</sup> of urine and the original full/total/complete delay of urine was changed by moving irretention.

The manometric investigations by R. P. Ugryumovoy revealed/detected that in these cases the tone of detrusor was usually increased, and its reflector excitability was intensified. But, at the same time, call reflex frequently rapidly was exhausted and therefore the full/total/complete emptying of the bladder it did

not attack/advance.

If conducting sensitive impulses/momenta/pulses from the bladder and the mucosa the initial divisions of urinating canal to the cerebral cortex one way or another was reduced, and the cortical innervation of external sphincter continued to remain disrupted, the alternate irretention of urine was combined with the imperative urges.

In the later periods in the reduction of the reflector emptying of the bladder and the absence of urges those wounded sometimes could to the known degree actively control the report/event of urination. For the causing of urination they resorted to the nipping, the tingling or stroking of skin of the internal surface of thigh or on the scrotum; evidently, skin stimulations stimulated the contraction/abbreviation of detrusor.

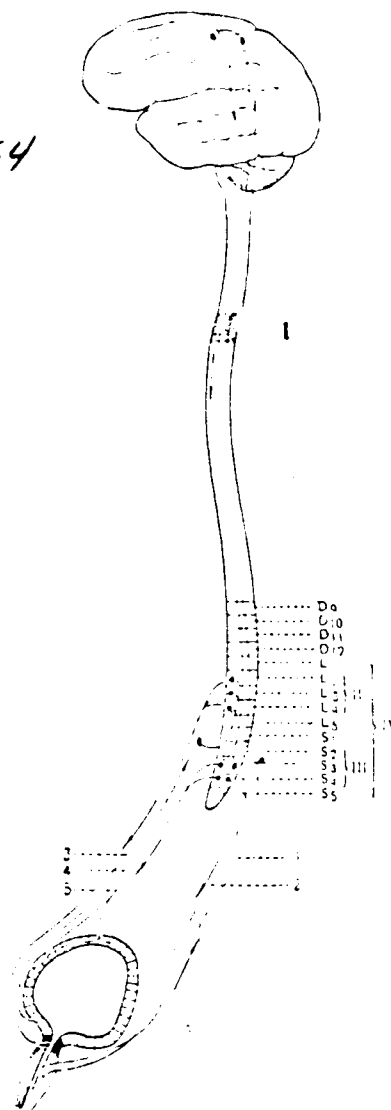


Fig. 45. Scheme of the innervation of the bladder. 1 - motor somatic filaments to the external sphincter of the bladder; 2 - sensitive somatic filaments to the mucosa of the initial division of urinating canal; 3 - vegetative (sympathetic) filaments to the internal sphincter of the bladder; 4 - sensitive vegetative filaments to the mucosa and the walls of the bladder; 5 - motor (parasympathetic) filaments to detrusor of the bladder. I, II, III, IV - explanation in the text.

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During the damages/defeats of the second, third and fourth lumbar segment (Fig. 45 II), in which is located the sympathetic center of the internal sphincter of the bladder, initially on the same reasons, that also during the higher damages/defeats, appeared the delay of urine and was disturbed the active control of urination. But the delay of urine was not usually heavy, since the tone of internal sphincter, although it was supported by the peripheral sympathetic ganglia/nodes (lower mesenteric web/plexus, hypogastric web/plexus), nevertheless its stress/voltage was weakened and was easily overcome by urine, even with a comparatively small overfilling of the bladder. Subsequently the delay of urine was usually changed by firm irretention, since the weakened sphincter easily lost the remainders/residues of its tone under the effect of the repeated catheterizations. As a result appeared the actual irretention of urine, i.e., urine always was secreted drop by drop in proportion to its admission from the ureters into the bladder.

During the partial reduction of the tone of sphincter appeared the alternate irretention, usually in combination with the imperative urges. However, with the full/total/complete interruption of

bladder-cortical sensitive routes/paths the casualty learned about the advanced urination only after the output/yield of urine.

The very heavy form of holding of urine appeared during the more or less isolated/insulated damages/defeats of a third-fourth sacral segment, which led to paralysis of detrusor with the preserved tone of internal sphincter (Fig. 45 III). With this localization of the damage of spinal cord comparatively frequently was noted the paradoxical irretention of urine. Subsequently, in connection with the partial reduction of the activity of detrusor or weakening of the tone of sphincter, under the effect of the prolonged catheterization, the full/total/complete irretention of urine was changed by partial - for the emptying of the bladder the casualty had to resort to straining, but the full/total/complete emptying of urine usually was not achieved, and the part of it remained in the bladder. Since the centers of the random innervation of bladder function are arranged/located in the medullary cone, then to a certain degree was disturbed the active control of the report/event of urination.

During the damages/defeats of entire lumbar- sacral thickening (Fig. 45 IV) more frequently predominated the delay of urine. But the heaviest and firm delay of urine appeared during the bilateral isolated/insulated damages/defeats of sacral rootlets. Internal sphincter in these cases retains its tone entirely; whereas motor and

the sensitive innervation of detrusor proves to be turned-off completely or to a considerable degree. As a result the reflector emptying of the bladder became impossible.

In the sharp/acute period of the bullet traumata of lumbar-sacral division of spine, which caused the sharp stimulation of sensitive rootlets, holding of urine sometimes had purely reflector character/nature; the stimulation of somatic sensitive rootlets, and possibly also sympathetic guides, it led, apparently, to the spastic contraction/abbreviation of internal sphincter. The reflector delay of urine had temporary/time character/nature and it was easily removed by the designation/purpose of pain relievers.

The reverse development of the disorder of bladder functions in the mild cases of the damages/defects of spinal cord began already within the next few days, but in the suppressing number of casualties the process of their reduction was involved/tightened to many weeks. In many, especially about the damaged lumbar-sacral division of brain and horse tail, the normal report/event of urination in that or other sense remained forever detuned.

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The disorders of the function of rectum were observed in 35.2%

those wounded in spine. The delay of feces was noted in 32.80/o, irretention - in 2.40/o. The reflector and active innervation of rectum is organized just as the bladder. Therefore everything presented above about the mechanisms of the disorder of the report/event of urination to the identical degree relates also to the report/event of defecation.

Constipation, which appeared on the soil of paralysis of rectum, differed in terms of large perseverance. Especially great difficulties on the emptying of intestine both active, and with the aid of the enemas, appeared when simultaneously were destroyed the sympathetic, and parasympathetic center of rectum. As a result of paralysis of parasympathetic center the intestine lost the ability to banish fecal masses, but as a result of paralysis of sympathetic center and caused by it weakness of the sphincter of intestine casualty was capable to hold enema fluid/liquid.

The irretention of feces rarely was observed as the stable residual symptom of the damage of a lumbar-sacral thickening. It caused to casualties inccapably greater sufferings than the irretention of urine.

During the damages of a lumbar-sacral thickening, it is thinner/less frequent during the damage of the higher divisions of



spinal cord, as a result of the disorder of trophic innervation in the rectum sometimes appeared the extensive ulcers, which were being rarely complicated by proctitis, and the latter - by thrombosis of venous webes/plexi and by sepsis.

The disorders of ejaculation and the loss of erection during the low damages of spinal cord were noted very frequently. During the damages/defects of medullary cone they in the residual conditions rarely came forward as the isolated/insulated phenomenon, whereas more frequent were combined with the violations urinations.

Violations of the vegetative functions of spinal cord.

The violations of the vegetative functions of spinal cord were observed approximately/exemplarily so frequently as somatic, and they were not less diverse. In the first world war this question was not sufficiently illuminated. Some general/common/total vegetative disorders are examined in the beginning of present chapter; are examined below the violations of more particular character/nature.

Cardiovascular violations. Besides the described above changes in the heart activity (decrease in arterial pressure, slowing pulse, dullness of heart tones), with the wounds of a upper-thoracic division of spine rarely were observed the attacks/seizures/paroxysms

of the type of stenocardia. In the case, described by N. I. Grashchenkov, heavy stenocardic attacks/seizures/paroxysms in a 23-year-old casualty appeared on the soil of stimulation by the metallic foreign body of the second left posterior thoracic rootlets. On the electrocardiogram was determined high tooth T. After the removal/distance of foreign body the attacks/seizures/paroxysms disappeared. The analogous cases were observed by others.

Above has already been indicated that during the damages of spinal cord in the divisions of body, innervated by sector to it downward from the focus, in the sharp/acute period appears the paralytic condition of vessels. Observation of their condition in the later periods showed that than is heavier the damage of spinal cord, the longer is held this condition. Especially the sharp and prolonged paralytic conditions of vessels were observed upon the full/total/complete transverse contamination of spinal cord or during the combined damages of back of cerebrum and frontier sympathetic shafts.

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Further dynamics of vascular violations depended on that, than they were a cause-fallout of impulses/momenta/pulses from the brain or an injury of spinal sympathetic centers and their guides. The

violations, caused by the fallout of central impulses/momenta/pulses, were equalized comparatively rapidly. During the damages/defeats of segmental vascular centers the process of reduction of vascular violations was involved/tightened for many months. Kh. M. Freydin and V. Smirnov during these damages/defeats found the atonic condition of capillaries within the periods of observations from 4 months to 2 years.

During the damages/defeats of the third, fourth and fifth thoracic segment vascular violations were noted also on the upper extremities, being escorted/tracked usually by the perception of numbness, weakness and their rapid enervation. At their basis lay/rested, apparently paralysis of the vascular centers of these extremities, placed in the segments indicated.

In the sharp/acute and early period vasomotor violations frequently were noted and internal organs/controls. To them first of all relates kidney hematuria. Its difference from hematuria on the soil of the wound of kidney or bladder was in the fact that the greatest intensity it achieved not immediately after wound, but on the 3-4th day. It was not usually sharp and it was frequently detected only via microscopic investigations. Comparatively rarely it lasted more than 1 1/2-2 weeks. The absence in the histories of the disease/sickness/illness/malady of recordings about the time of the

appearance of hematuria and about a change of its intensity with time sometimes impeded the correct recognition of its vasomotor pathogenesis. In any case in the subsequent stages evacuation one should not hasten to conclude that at the basis of hematuria lies/rests the wound of kidneys or bladder, but those more too in a hurry to solve in the positive sense the problem about surgical intervention on the kidney. In the first world war were published the cases of intervention on the kidneys apropos vascular-trophic hematuria, which erroneously accepted as the consequence the wounds of kidneys.

Bladder hematuria in the sharp/acute period appeared not only with the wounds of the bladder, but also as a result of transudation of the blood from the vessels of the mucous membrane of the bladder, but sometimes also their break (A. I. Vasil'yev). The reason for these hemorrhages was, probably, sharp passive hyperemia of the vessels of mucosa of the bladder, which attacked/advanced as a result of the surprise elimination of the pressure on them of the urine, released by catheter. In a few cases occurred and the gap of fine/small vessels. In order to avoid during the catheterization of these complications, one should have discharged urine slowly, at times stopping its discharge, especially in the end.

In later periods hematuria usually was connected with the onset

of hemorrhagic or ulcerous cystitis, and also hemorrhagic nephritis development of which very favored a deep violation of the vascular and trophic innervation of the bladder and kidneys. Hemorrhagic cystitis especially frequently was developed upon the full/total/complete transverse contamination of spinal cord. For example, N. N. Ovchininskiy observed hemorrhagic cystitis in all casualties with this form of the damage of spinal cord.

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During the heavy damages/defeats of the thoracic division of spinal cord, as a result of the violations of a vascular-trophic innervation of gastrointestinal canal, in separate casualties it was observed bloody vomiting and bloody chair/stool, disorders of a gastrointestinal secretion and motors. Bloody chair/stool more frequently arose in the case of damages of the lumbar-sacral enlargement. In later periods most frequently the blood entered the lumen of intestine from the trophic ulcers of intestine.

One of the manifestations of vascular violations was priapism. At its basis lies/rests the overfilling of cavernous bodies by the blood as a result of the paresis vacular-motors. The wide-spread opinion that priapism is observed almost exclusively during the damages/defeats of the neck division of spinal cord, is accurate. The onset of priapism with the wounds of the thoracic division of

spine in the last war was observed by many surgeons for long - to 1 1/2-2 weeks, and in the single cases and to 1 1/2 months.

Disorders of perspiration. In the sharp/acute and early period during the heavy cross damages/defeats of spinal cord the perspiration on the paralyzed divisions of body usually temporarily disappeared; therefore skin was dry to the touch and, as a result of the paresis of vascular motors, hotter. However, in proportion to reverse developments cerebrospinal shock local (reflector) perspiration was reduced, central as a result of the interruption of the guides, that go to the spinal cord from the intermediate, remained long disrupted.

In a number of cases of the rough damage of spinal cord at the level of upper thoracic segments in the later periods in some casualties was observed the following peculiar phenomenon: in 30-40 seconds prior to the beginning of the automatic emptying of the bladder the head, face, neck and upper divisions of breast were covered/coated with the abundant, major drops of perspiration. Occurrence of perspiration served for the patients with the signal of the forthcoming involuntary urination. With the termination of urination the perspiration ceased.

The principles of this phenomenon are not clear. Evidently,

afferent impulses/momenta/pulses from the overfilled bladder on the spinal cord or on the frontier sympathetic shaft achieved perspiration centers of intermediate brain, but effector impulses/momenta/pulses, as a result of the interruption of the corresponding routes/paths, could not spread on the region of body of lower than the focus. Thinner/less frequent under the same conditions suddenly appeared the reddening of face, neck and upper divisions of chest.

The syndrome of sharp/acute stomach, which was being frequently observed in the sharp/acute period of the bullet wounds of spine, in detail is examined in the section of complications.

Hiccup. With the wound both of the neck and thoracic division of spine rarely was observed the agonizing hiccup, which did not be inferior to conventional pharmacotherapy. In similar cases was obtained a good effect only with the neck vagosympathetic blockade by novocaine.

With the wounds of the neck division of the spine when by the wounding shell was interrupted the vagus nerve, in some casualties subsequently were observed the agonizing attacks/seizures/paroxysms of cough. Attacks/seizures/paroxysms appeared under the effect of stroking, dash stimulation, touch of clothing to the post-injury scar

and to the adjacent to it divisions of skin. P. K. Anokhin explains the onset of this peculiar skin of coughing reflex by the growing of the filaments of the vagus nerve into the peripheral end of the smashed neck sensitive nerves.

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#### Endocrine disorders.

The damage of the spinal centers of endocrine glands, and sometimes also glands themselves laid on the clinical picture of fire wound of spinal cord the corresponding impression. Unfortunately, in the Great Patriotic War neuropathologists gave to the endocrine disorders insufficient attention. Most frequently was noted the syndrome of tetany perhaps because of all endocrine disorders it more easily others attracted attention. The reason for tetanic spasms some (N. I. Grashchenkov and M. S. Chetverikov) perceived in the violation of the innervation of parathyroid glands, others (I. Ya. Razdol'skiy) in the unit of the cases allowed/assumed damage of parathyroid glands (contusion, hemorrhage in them).

The internal introduction of calcium chloride, parathyreocrin is had on spasms a very favorable effect.



Little illuminated remained the role of the damage of the secretory centers of the adrenal glands and them themselves in the clinical picture of the bullet wounds of spinal cord. Meanwhile the value of the disorder of their function in this respect is doubtless. With the wounds of last thoracic and first three lumbar vertebrae in separate casualties was observed the long existed and sharply pronounced general/common/total and muscular adynamia and arterial hypotonia. Their reason was, apparently the suppression of the functions of the adrenal glands as a result of damaging of their their or cerebrospinal centers themselves and nerves. In some of these casualties was developed the typical syndrome of Addison (I. Ya. Razdol'skiy). Section came to light/detected/exposed in them the sharp atrophy of the adrenal glands and the traces of the available damages.

Cerebrospinal shock (spinal shock).

Each any considerable sharp/acute cross damage of spinal cord is escorted/tracked by the suppression of all reflector functions of its division, arranged/located down from the focus of the damage: weaken or disappear tendinous-periosteal, skin, vascular and secretory reflexes, descends the tone of muscles, is disturbed the automatic emptying of bladder and rectum. This paralytic of the condition of the reflector activity of spinal cord is since often times called

cerebrospinal or spinal shock.

Apropos of the pathogenesis of cerebrospinal shock to the Great Patriotic War dominated the theory, according to which its reason is the surprise stopping of pulse arrival from the brain to the back as a result of an injury of the corresponding guides at the level of focus. In this case regarding those divisions of brain, the disconnection of impulses/aomenta/pulses from which led to the development of the cerebrospinal shock of unanimity between the supporters of this theory was not. One (Monakov) they assumed that by this division is the motor region of the brain core, other-nucleus/kernel of spendthrift (Sherrington) or cerebellum (Bastian). The changes, which were the basis of shock, were examined in essence as functional-dynamic; the proof of this was considered the reversibility of shock. Exceptions were only the cases of the full/total/complete transverse contamination of spinal cord, with which, according to the observations of Bastian and Bruns, reflector functions of that lying of below the division of spinal cord they are not reduced.

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Soviet neuropathologists the Great Patriotic War assembled large factual material which, in the first place, showed that it is not

possible all cases of the loss of the reflector activity of spinal cord to explain by cerebrospinal shock in its classical understanding, and, in the second place, it made it possible to introduce the new points of view into the explanation of the pathogenesis of shock itself.

The higher the level of the damage of spinal cord, the more rapid with the same severity of damage is reduced the reflector activity. The following four short extractions from the histories of disease/sickness/illness/malady illustrate the aforesaid.

Sick gr obtained 27/VIII 1943 blind bullet penetrating wound of spine at the level of the IV neck vertebra. Immediately after wound prolonged loss of consciousness, paralysis of all four extremities the delay of urine and chair/stool. After 3 days of pain in the neck. Claude Bernara-Gorne's bilateral symptom. Paralysis of all four extremities. Atony of muscles. Full/total/complete anesthesia from the fourth neck segment is below; in particular, it does not perceive the compression of the fold of skin in the region and the toe, feet, gastrocnemius muscles. Passive movements it weakly perceives only in the shoulder joints. Reflexes on the upper extremities are not caused, on the lower ones - extremely flaccid, especially on the left. Bottom reflexes are sharply weakened, rapidly they are exhausted. To the right is caused the symptom of Bekhterev ' (flexure

of fingers/pins during the tapping by percussion malleus on the external half the rear of foot).

FOOTNOTE 1. This symptom usually is designated as the symptom of Mendel-Bekhterev, which is incorrect, since it is described by Bekhterev in 2 years earlier than this made Mendel (Mendel).  
ENDFOOTNOTE.

Remaining pathological stop symptoms are absent. Absence of urges for the urination. Full/total/complete delay of urine and feces.

After 14 days - anesthesia from the fifth neck segment. Appeared weak reflexes from the biceps on both upper extremities, bilateral symptoms of Babinski, Rossolimo, Bekhterev. Tendinous reflexes on the lower extremities are pathologically increased. In other respects without the changes. Lethal outcome in 1 1/2 months from heavy cachexia.

Data of autopsy the break of spinous process and small arc of the V neck vertebra. In the solid cerebral shell to the left defect by the size/dimension 1.5x0.5 cm. The fourth and fifth neck segments were crushed; in the substance of the fifth neck segment hit the ground small-gauge bullet. For entire remaining elongation/extent brain without the macroscopically visible changes.

Sick K-n 20/VII 1944 was obtained tangential penetrating wound of spine at the level of the III thoracic vertebra. At the moment of wound perceived the breakaway of the lower unit of the body. During the first day tested/experienced the perception of numbness and the weakness in the upper extremities.

25/VII paralysis and atony of lower extremities. Anesthesia from the fourth thoracic segment. Passive movements in lower extremities it does not perceive. Patellar reflexes are absent, achilles flaccid, to the right Babinski's symptom. Light swelling of foot and shin of the left strut. Delay of urine and feces. 28/VII lethal outcome.

Data of autopsy the break of small arc of VIII thoracic spine. Spinal cord at the level of the body of this vertebra is crushed is paste-like sulfur-red mass; for entire remaining elongation/extent without the macroscopically visible changes. Solid cerebral shell is not damaged. Right extensive hemothorax.

Sick S. obtained 13/III 1942 the tangential penetrating bullet wound of spine at the level of the VII thoracic vertebra with the full/total/complete violation of the conductivity of spinal cord at the level of the eighth thoracic segment. After 6 days paralysis of

lower extremities with the sharply pronounced atony of muscles and the loss of skin and tendinous reflexes. Loss of all forms/species of sensitivity, including the musculoarticular from the eighth thoracic segment. Delay of urine and feces. Solid edema of feet and shins. No reflector functions, realized by the lying/horizontal below division of spinal cord, were reduced. Casualty died 29/V.

Data of the autopsy: the break of small arc of the VII thoracic vertebra. The integrity of solid cerebral shell is not disrupted. At the level of the body of this vertebra all three cerebral shells are loosely soldered between themselves and the spinal cord completely crushed. Down from the focus spinal cord is somewhat edematic, its vessels initiated especially vein.

Sick N. was obtained the blind-end bullet wound of spinal canal at the level of the X thoracic vertebra without the damage of solid cerebral shell. Intra-medullary cyst of spinal cord on the soil of its contusion. Extensive bedsores on the rump, the thighs, the heels scar after the soft tissues of head. Heavy cachexia. Pyonecrotic cystitis. It is wounded 6/VII 1943. At the moment of wound it experienced the perception of the breakaway of feet, "he thought that in me remained only the head and body". It is for the first time was examined by neuropathologist 21/VII. Full/total/complete lower paraplegia. Loss of all reflexes, atony of muscles. Loss of

sensitivity from IX thoracic segment. Paralysis of bladder and rectum. Solid edema of lower extremities. Casualty it perished in 1 month of 10 days after wound. None of the reflexes on the lower extremities was reduced.

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Data of the autopsy: the destruction of right half body and small arc of the X thoracic vertebra. With respect to this spine extradurally is arranged/located pointed bullet. Solid cerebral shell is not damaged, but at this level is tightly joined with soft B back to cerebrum at the level of X thoracic spine there is area in length in 2 cm, surrounded by the remainders/residues of white substance. In the cross shear/sections the figure of a lumbar-sacral thickening is somewhat greased, visible the remainders/residues of the former fine/small hemorrhages, brain tissue is edematic.

In all 4 wounded severity of the cross damage of spinal cord it was approximately/exemplarily identical. But while in the first of two (with the high localization of wound) reflector activity of a lumbar-sacral division of brain it began to be reduced already within the next few days after wound, in latter/last two (with the lower localization, but higher than lumbar-sacral thickening) it did not detect tendency toward the reduction and through 4-5 weeks. The hence

natural conclusion that the surprise stopping of pulse arrival from the brain to the division of spinal cord, arranged/located is lower than the stricken area, even from the point of view authors' mentioned above, is not the sole reason for the suppression of its reflector activity.

Further confirmation of correctness of this conclusion/derivation are the facts, which attest to the fact that the degree and the duration of the suppression of the reflector activity of spinal cord depend not only on severity and level of its damage/defeat, but also on the character/nature of damage/defeat. The rougher the trauma, plotted/applied to spinal cord, the more lately are reduced the reflector functions. For example, with any rough contusion of the thoracic division of brain, even not calling its full/total/complete transverse contamination, reflexes on the lower extremities were reduced very slowly. On the contrary, with the cutting of brain, bringing about the same or an even larger intensity the damage of spinal cord, they were reduced significantly earlier and it is more rapid. The following two histories of disease/sickness/illness/malady illustrate the aforesaid.

B. obtained 13/III 1944 tangential fragment penetrating wound of spine at the level of the IV thoracic vertebra with the contusion of brain at this level. Immediately after wound paralysis of lower



extremities with the perception of their breakaway, delay of urine and feces. After 5 days: lower paraplegia with the loss of skin and tendinous reflexes. Weakening skin sensitivity in the region of the third and fourth thoracic segment and its loss from the fifth thoracic segment. Delay of urine and chair/stool. X-ray analysis: the break of the posterior division of small arc of the IV thoracic vertebra. Foreign body (metallic fragment by the size/dimension 1.5x0.8 of cm) is arranged/located on 3 cm to the left from the line of averted extensions at the level of this spine 28/III they appeared insignificant movements in the fingers/pins of the right strut. Babinski's symptom to the right distinct, to the left - the form/species of hint. Patellar and abdominal reflexes are absent. Achilles reflexes flaccid, cremaster - active. Perceives the compression of calf muscles, feet, and also rough injections for entire elongation/extent, beginning from the fifth thoracic segment 30/III laminectomy. Is removed the damaged small arc of the IV thoracic vertebra. Scrap of small arc is depressed into the lumen of spinal canal and it fits solid cerebral shell. Solid cerebral shell is not damaged.

After wound flaccid paralysis became spastic, in 2 months casualty began to be moved with the aid of the crutches, in 3 months freely it walked with the aid of the stick.

It is obvious, scrap of small arc, which was incorporated in the lumen of spinal canal, applied to spinal cord rough contusion, after leading thereby to the development of heavy shock; but the caused by it changes in the brain, as showed further observation, in essence they had the reversible character/nature.

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S. obtained 17/VI 1943 the multiple fragmentation penetrating wound of spine with the partial violation of the conductivity of spinal cord at the level of the body of the eighth thoracic segment.

At the moment of wound it stood. Immediately after wound paralysis of lower extremities. Active movements in the right strut appeared after 40-50 minutes. 21/VI paralysis of left lower extremity and insignificant paresis of right. Loss of painful and temperature sensitivity to the right from the eighth thoracic skin segment. The musculoarticular feeling in the fingers/pins of the left strut is roughly disrupted, in right- it is preserved. Knee and achilles reflexes are increased, it is sharper to the left. Babinski's symptom two-way, more distinctly is expressed on the left strut. Urination with the considerable stress/voltage. In the X-ray photographs bone damages it is not determined. In the region of bodies of the V and VI thoracic vertebra penetrate two fine/small metallic fragments.

Laminectomy 2/VII 1943. In the upper division of small arc of the V thoracic vertebra defect the size of a grain of wheat. Upon incision of the small arc of the V and VII thoracic vertebra appeared the escape of cerebro-spinal fluid.

In the left half the sack of solid cerebral shell the defect of oval form, through which is discharged the cerebro-spinal fluid. In the left half spinal cord seemingly cut wound, which sufficiently deeply penetrates into its substance. Stitching on the defect in the solid cerebral shell.

As showed further observation (for a period of 3 months), volume and force of the active movements of the right strut were reduced almost completely; the movements of the left strut remained negligible, and painful and temperature sensitivity on the contradictory/opposite half the body of that lost.

In the given observation the sharp/acute metallic fragment of small sizes/dimensions reproduced seemingly partial experimental section of brain, slightly traumatizing the adjacent divisions of the latter. As a result, in spite of the destruction of the left half spinal cord, the reflexes of the paralyzed extremity although were lost, on the 5th day (up to the moment/torque of the examination/inspection of patient) have already been reduced.

The dependence of the duration of the loss of reflexes not only from the severity of the cross damage of spinal cord, but also from its level and character/nature (cutting, crushing) showed that it is conditioned not only on cerebrospinal shock, but also on some additional factors.

Already in the first world war a number of the authors (M. Lapinskiy et al.) found in the presence of the rough transverse contaminations of the spinal cord of the various kinds of change in the cut of brain, which lies lower than the focus: edema of brain and cerebral shells, foci of hemorrhages and softenings.

In similar a Great Patriotic War the changes were described by many Soviet pathomorphologists (L. I. Smirnov, Ye. A. Uspenskiy et al.). They are they were usually the more considerable, the rougher there was the damage of spinal cord. Microscopic examinations came to light/detected/exposed the bloating of the body of nerve cells, the rarefaction of Nissl substance, the displacement of cell nucleus to the periphery, the decomposition/decay of the terminal branchings of nerve fibers and their synapses, etc. All these macro- and microscopic changes in the substance of spinal cord, coming forward in one or the other combinations, must suppress the reflector ones of functions.

In the later periods in the division of spinal cord, arranged/located it is lower than the damage, appeared the changes and another order, which also act depressingly on its reflector functions. To them first of all relate the changes in the shells. Sharp/acute and chronic pachymeningitis and especially arachnoidites, which frequently cover the extensive divisions of this cut of spinal cord, squeezing rootlets and vessels, especially venous, and disturbing liquor and blood circulation, not only impeded the reduction of reflector functions, but sometimes they led to the disappearance of those already reducing.

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Finally, in the unit of the cases, especially when the blockade of sub-arachnoidal space is present, the suppression of the reflector functions of spinal cord was supported by the toxins, which entered on perineural lymphatic vessels from the bedsores and from the infected urination system.

Thus, the suppression of the reflector activity of the division of spinal cord down from the stricken area, besides the surprise stopping of the arrival to it of pulses from the brain, was conditioned both on onset in this division of the supplementary foci of damage/defeat, violation of roof and lymph circulation, on

inflammatory changes in the snells and in the tissues of epidural space, and sometimes and by the action of toxins. In comparatively mild cases of damages/defeats of the spinal cord basic reason that suppressed its reflector activity, was the sharp/acute stopping of the arrival to it of the pulses from brain, i.e., its genus "cerebral denervation" it; in the heavy cases to the latter were connected those, etc. of the enumerated factors. The correctness of this position/situation confirm the described above observations. In all 4 casualties occurred the full/total/complete transverse contamination of spinal cord. But in two of them (with the high wound of spinal cord) at its division, which lies it is lower than the place of damage, in particular, in a lumbar-sacral thickening, no changes it was discovered, and the reflector function of this division began to be reduced soon after wound. In other two casualties at the division of brain, which lies down from damage, were discovered fine/small hemorrhages, swelling, expansion of veins, i.e., morphological changes; both these casualties to the onset of the flying issue of any symptoms of the reduction of the reflector activity of this division of spinal cord discovered did not have.

Observation of the reduction of the reflector functions of brain came to light/detected/exposed the following. The suppression of reflector functions, caused by the shock of spinal cord, in the mild cases began to undergo reverse development already within the next

few days after wound, in the heavy ones - after 10-14 days. However, caused by supplementary foci and disorders of blood circulation the suppression of reflector functions was reduced on the liquidation of these violations, sometimes after 3-4 and more than weeks. Finally, the suppression of reflexes, supported by the connected pachymeningitis, arachnoiditis (especially during its dissemination to the region of horse tail), by action of toxins, remained stable.

Thus, the experiment/experience of the Great Patriotic War showed that during the bullet damages/defeats not any suppression of the reflector functions of spinal cord can be considered as the manifestation of cerebrospinal shock. In particular, if their loss lasts more than 2 1/2-3 weeks, which to call this condition shock is incorrect. The loss, for example, of tendinous reflexes, that remains after 3 and more than weeks, it is the result no longer of shock, but local, frequently stable morphological changes in the lying/horizontal below cut of spinal cord. Convincing proof and this-appearance during tightening itself are reflection of the atrophy of muscles and a change in their electroexcitability up to the reaction of degeneration. This fact was established/installed already in the first world war (L. M. Pussep et al.) and it was confirmed by the Soviet authors in the Great Patriotic War.

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Together with the criticism of the existed representations about the reasons for the suppression of the reflector activity of spinal cord during its bullet damages/defeats, was advanced the new point of view to pathogenesis and essence of cerebrospinal shock.

It was above indicated that according to Monakova-Sherrington-Bastian's theory, the reason for shock is the surprise stopping of the influx of impulses/moments/pulses from the brain to the division of spinal cord, arranged/located lower than the focus of damage. But this theory of cerebrospinal shock at basis of which lies/rests as "cerebral denervation" of spinal cord, is located in the full/total/complete of contradictions both with the history of the development of nervous system and with the fundamental facts, established/installed by I. M. Sechenov and I. P. Pavlov.

In the process of the evolution of nervous system its progressively developed youngest division (cortex of the large hemispheres) amplified its controlling and inhibiting action during the function of the underlying divisions of nervous system and, in



particular, spinal cord. Therefore the release of spinal cord from the action of cortex leads to reinforcing of its reflector activity. This occurs with cross damages of spinal cord, which develop not suddenly as with its traumata, but gradually as, for example, with the neoplasms, in particular, in that stage of the development when they cause the full/total/complete violation of the conductivity of brain. Thus, Monakova-Sherrington-Bastian's theory about the pathogenesis of cerebrospinal shock is in contradiction not only with the history of the development of nervous system, but also with the facts.

On the contrary, pathogenesis and essence of cerebrospinal shock find their full/total/complete explanation in light of the exercise of I. M. Sechenov and I. P. Pavlov.

I. M. Sechenov almost 100 years ago in the experiments on the frogs showed that the stimulation of the guides, that go to the spinal cord from the head (application of the crystalline particle of common salt to the extremital division of brain stem, severed at the level of quadrumounting), leads to the sharp suppression of the functions of spinal cord. From the experience of Sechenov it appears, that the suppression of the functions of spinal cord is the result not of the fallout of the influx of impulses/moments/pulses to the spinal cord from the head, and, on the contrary, sharp reinforcing

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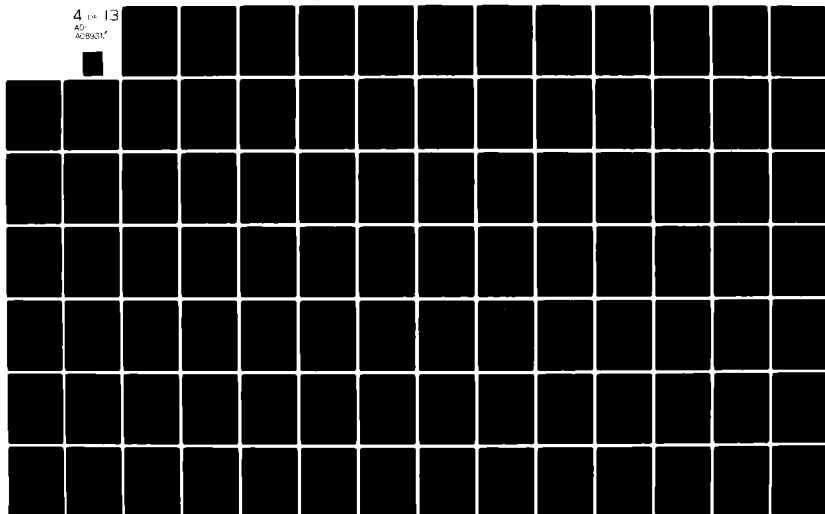
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EXPERIENCE OF SOVIET MEDICINE IN A GREAT PATRIOTIC WAR 1941-194--ETC(U)  
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their I. P. Pavlov in his works on the extirpations of different divisions of the large cerebral hemispheres of dog not only spread and he deepened I. M. Sechenov's exercise about the suppression of the functions of spinal cord under the effect of the strong stimulations, which flow to it from the brain (it is special from the cortex), but also opened the essence of the process, which lies at basis of this suppression. It showed that the damage of the cerebral cortex is escorted/tracked by the onset in it of diffused inhibition. The rougher the damage, the more disseminated the inhibition. During the especially rough damages it captures not only cortex, but also subcortical divisions, including spinal cord, suppressing its reflector activity.

In light of I. P. Pavlov's exercise about the higher nervous activity becomes completely clear the suppression of the reflector activity of spinal cord with his sharp/acute traumata. The cross damage of spinal cord is escorted/tracked by the instantaneous and strong stimulation of the guides, that go from the brain core to the division of spinal cord, arranged/located lower than the stricken area.

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As a result of surprise influx to the nerve cells of this division of

the spinal cord of extremely strong impulses/momenta/pulses in them appears the beyond the limits, protective inhibition, external manifestation of which is the full/total/complete suppression of its reflector activity, i.e., the condition which by clinicians is designated as cerebrospinal shock. The heavier the damage of spinal cord, the more strong the pulse stream and the deeper and more prolonged caused by them inhibition. Thus, reason for cerebrospinal shock with traumatic damages of spinal cord is not stopping the influx to it of impulses/momenta/pulses from the brain, as this they asserted Monakov, Sherrington and Bastian, but, on the contrary, the surprise influx of extremely strong impulses/momenta/pulses, as this appears from I. P. Pavlov's exercise about the higher nervous activity.

On the basis of I. P. Pavlov's exercise about the healthful value of protective inhibition, E. A. Asratyan during the traumatic damages/defeats of spinal cord applied carotid therapy, after noting its favorable effect on the reduction of the disrupted functions.

Were expressed also the new points of view, also, to the pathogenesis of the disorder of the conductor functions of spinal cord (I. Ya. Razdol'skiy).

According to the existed representations, during the incomplete

cross damages of spinal cord the loss of motor and sensitive disorders in the sharp/acute period is conditioned on the temporary/time violation of the conductivity of nerve fibers in the region of the focus of damage. The reason for the violation of conductivity they perceived in such changes in this sector of the nerve fibers, in essence of microstructural ones, which, without leading them to the death, made the dissemination on them of impulses/momenta/pulses impossible.

But microstructural changes in the nerve fibers are not the sole reason for the violation of the dissemination on them pulses. Together with them, act other factors. Thus, it was shown (Yu. M. Uflyand), that the action on the traumatized spinal cord by electric current improved conductor motor and sensitive functions. It is obvious, in the sectors of nerve fibers in the region of focus under the effect of the trauma appeared the parabiologic condition (in the sense of Vvedenskiy), which led to the blockade of nerve impulses. The elimination of this parabiologic condition by electric current caused an improvement in the conductor functions. But weakening or even loss of the motor and sensitive functions of spinal cord in early nature of its partial bullet damages/defects was conditioned not only on the disorder of conducting impulses/momenta/pulses on the nerve fibers as a result of the microstructural changes and the parabiologic condition in them at the level of focus. Important value

in this respect belongs to the adynamia of cells and synapses as one of the manifestations of cerebrospinal shock. As a result of this adynamia the nerve impulses, which flow on the pyramidal filaments, cannot be disseminated to the motor cell and impel it to the activity, but the impulses/momenta/pulses, which flow on the rear cortical filaments, be switched to the sensitive cells of posterior crescents and further be disseminated into the brain core. In favor of this point of view speaks favorable effect on the reduction of motor functions - during the bullet damages/defeats of the spinal cord of the cholinergic substances (eserine, Prostigmin, proserin), which act, as is known, on the synapses and on the nerve cells. To the positive effect from the use/application of these substances during the bullet damages/defeats of spinal cord indicated many (N. I. Grashchenkov, N. S. Chetverikov et al.).

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To the Great Patriotic War as the basic signs of the reduction of the reflector activity of the division of spinal cord from the stricken area they were down considered: the reduction of tendinous and periosteal reflexes and automatic emptying of bladder and rectum, the appearance of pathological reflexes, an improvement in the trophic system of tissues. On the basis of the experiment/experience of the Great Patriotic War for this purpose was proposed the

series/number of new tests. They all are based on the determination of the condition of vegetative functions. Most valuable of them following.

Investigation of the vesical reflex in the presence in the wounded artificial urino-vesical fistula (R. P. Ugryumova). In the bladder through the fistula were introduced antiseptic solutions/openings and with the aid of the manometer they determined the intravesical pressure, at which appeared the urination. The presence of the vesical reflex testified about the reduction of the reflector activity of spinal cord. The investigation of the urino-vesical reflex has the high value during the decision/solution of a question about the time when should be eliminated the urino-vesical fistula.

Study of the reaction of the skin vessels of the paralyzed division of body to the subcutaneous introduction of adrenaline (S. Lifshitz). It was above indicated that in the vessels of the paralyzed divisions of body immediately after wound appears the paralytic condition and that this condition is held the more long-term, more heavily damaged the cerebrospinal vasomotor centers. With paralysis of centers the vessels in response to the subcutaneous introduction of adrenaline are not narrowed, but, on the contrary, they are expanded. Thus, the normalization of their reaction to

adrenaline is the indicator of the reduction of the reflector activity of spinal cord.

The specific value in this respect have the investigations of dermatographism (T. Yu. Yakubovskiy) and perspiration (Yu. V. Il'in). The authors showed that the normalization of these functions is an important indicator of the reduction of the reflector activity of spinal cord.

Are very interesting changes of the blood in the divisions of body with disrupted dermatographism and perspiration (S. A. Georgiyev). Is revealed the presence in divisions of the peripheral blood of the vessels of these divisions of high leukocytosis, which achieved 20-25-30 thousands in 1 mm<sup>3</sup>; leukocyte formula usually did not change.

Established/installed data are of large interest not only as the indicators of a deep disorder of vegetative functions of spinal cord, they have important practical value. Usually the blood is taken from the vessels of the fingers. With paralysis and deep paresis of upper extremities the value of leukocytosis as the indicator of the infectious complication of the wound of spine should be estimated with the care.



Basic clinical syndromes of bullet wounds and damages of spinal cord.

Syndromes of the partial and full/total/complete violation of the conductivity of spinal cord.

Morphological changes in the spinal cord during the bullet wounds and the damages oscillated over wide limits - from the jolt to the full/total/complete transverse contamination. The basic forms of these changes are schematically represented in Fig. 46.

For the short clinical characteristic of the degree of the violation of the functions of spinal cord with its bullet wounds in the Great Patriotic War extensively were used the following terms: the physiological interruption of spinal cord, the anatomical interruption of spinal cord, the full/total/complete transverse contamination (or damage) of spinal cord, the partial destruction (or damage) of spinal cord, contusion, jolt.

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The diversity of terms for the characteristic of the violation of the functions of spinal cord and the fact that three of them (anatomical interruption, full/total/complete damage of brain, partial damage of brain) are concepts not functional, but

morphological, and can be established/installed only on the operation/process, on the autopsy or after prolonged observation, they advanced in the course of war the need for establishing/installing the terminology, based on the functional principle. Thus, in the series/number of fronts for the characteristic of the full/total/complete fallout of the functions of brain entered into the practice term "full/total/complete violation of the conductivity of brain", and for the partial fallout the "partial violation of the conductivity of brain".

The term "full/total/complete violation of the conductivity of spinal cord" designated the total loss all of its conductor functions, and during the damage of horse tail - all rootlets of the latter down from the stricken area. The condition, in which were retained at least some functions of spinal cord or damaged rootlets of tail, was designated as the partial violation of conductivity. The degree of the partial violation of conductivity can oscillate from the light to the extremely heavy.

These terms should be recognized more advisable. their advantage consists in the fact that they do not predetermine the character/nature of those pathomorphological changes which are the basis their and which, as noted above, in the majority of the cases they can be established/installed only on the autopsy, on the operation/process or after prolonged clinical observation.

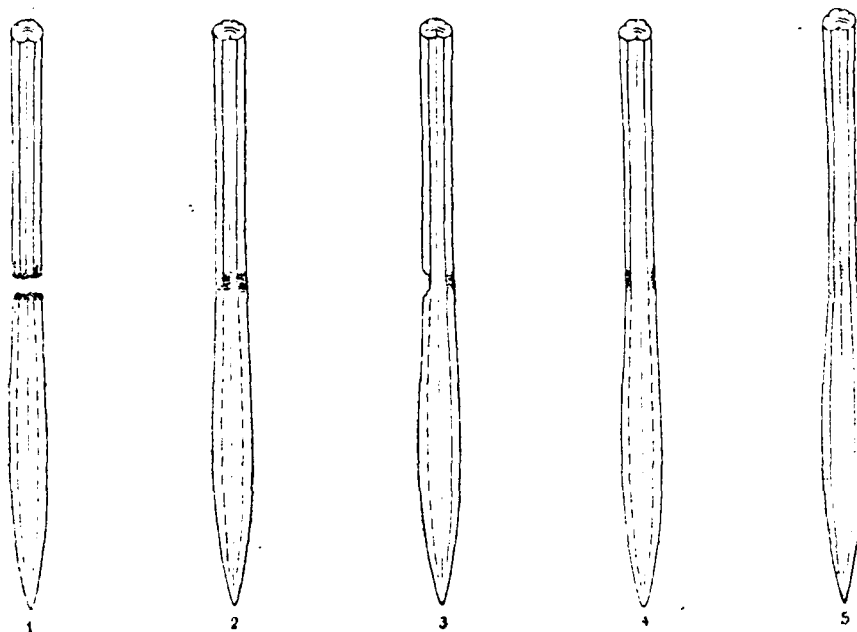


Fig. 46. Basic forms of the bullet damages/defeats of spinal cord (scheme). 1 - full/total/complete anatomical interruption of brain; 2 - full/total/complete are axonal <sup>and</sup> interruption; 3 - partial anatomical interruption with the contusion of the remaining part of it; 4 - contusion of spinal cord with the partial axonal interruption; 5 - brain concussion. broken line showed the divisions of the damaged nerve fibers, which undergo degeneration.

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In particular are undesirable for the characteristic of the condition of the functions of brain the terms "physiological

interruption" and the "anatomical interruption of brain".

Physiological interruption - this is the functional condition of spinal cord which in the sharp/acute and early period can be observed with different morphological forms its damage. Meanwhile the analysis of the histories of disease/sickness/illness/malady showed that physiological interruption they frequently identified with the anatomical interruption. As a result the percentage of the diagnoses of anatomical interruption in some authors proved to be sharply high.

According the data of the development of the histories of disease/sickness/illness/malady, the full/total/complete violation of the conductivity of brain in the early period was noted into 24.80/o of all bullet wounds of spine. Quantitatively it sharply predominated with the penetrating wounds of spine (46.90/o), whereas with the nonpenetrating ones it was observed as an exception (4.50/o).

The full/total/complete violation of the conductivity of spinal cord was considered as the indicator of its very heavy damage/defeat. Presence its majority of the neuropathologists and neurosurgeons estimated as the sign which darkens not only functional (in the sense of the reduction of the disrupted functions), but also vital prognosis of casualty. Actually/really the experiment/experience of the Great Patriotic War showed that the absence of the junction of the full/total/complete violation of the conductivity of spinal cord

into the partial after 5-6 weeks after wound makes functional prognosis almost hopeless, and vital - by very doubtful. Thus, according to the data of GBF (Leningrad), from the casualties with the syndrome of the full/total/complete violation of the conductivity of spinal cord it survived only 4.50/o. The given data about the forecasting importance of the full/total/complete violation of the conductivity of spinal cord must impel neuropathologist to be extremely cautious upon the setting of this diagnosis, especially in the sharp/acute and early period. Meanwhile the analysis of the histories of disease/sickness/illness/malady revealed/detected that the diagnosis of the full/total/complete violation of the conductivity of brain was placed sometimes in such cases where in actuality occurred its partial violation. Is explained this first of all by the incompleteness of examination/inspection, especially sensitive functions.

With the bullet wounds of spinal cord the foci with respect to the diameter of brain can be distributed by the most whimsical mode. While its some divisions can be completely destroyed or, in any case, their function completely oppressed, others can to a certain degree be preserved. Therefore in order to recognize the diagnosis of the full/total/complete violation of the conductivity of spinal cord as that substantiated, it is necessary to investigate all its basic conductor functions: motor, painful, feverish, and also the

musculoarticular feeling. Upon the examination/inspection of the sensitivity, especially painful, it is not possible to be limited to usual methods, i.e., by tingling by the pin, sharpened by goose pen, etc. Not only with the rough morphological damages of spinal cord, but even during the temporary/time violations of conductivity its, caused by contusion, edema, fine/small hemorrhages, these stimulations during the first days after wound can by casualty not be perceived. In order to be convinced of the total loss of conducting impulses/momenta/pulses on the painful guides, it was necessary to resort to the more energetic stimulations, for example, to the strong compression of the seized between the fingers/pins fold of skin, gastrocnemius muscles, foot, fingers/pins, eggs. If casualty did not receive in the presence of full/total/complete paralysis and these stimulations, and also he did not perceive passive movements in the large/coarse joints of the paralyzed extremities, then the diagnosis of the full/total/complete violation of the conductivity of spinal cord could be considered substantiated.

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Nonutilization by neuropathologists of this rougher investigation of sensitivity sometimes led them to the erroneous conclusions. As an example can serve the following observation.

L-ko obtained 21/III 1943 the blind-end bullet penetrating wound of spine at the level of the XII thoracic vertebra with the full/total/complete violation of the conductivity of spinal cord from the level of the second lumbar segment. X-ray analysis (23/III): bullet was wedged in into the posterior division of the left half body of the XII thoracic vertebra. The point of bullet was directed toward the rear, down and somewhat towards the inside and on the average of lines penetrates the spinal canal, fulfilling it at the level of the awned extension of this vertebra. Neurologic examination/inspection from 23/III: flaccid lower paraplegia with the loss of tendinous and skin reflexes. The delay of urine and chair/stool from the level of the second lumbar segment on both feet does not perceive after pricking, touches, temperature stimulations the conclusion: the blind-end bullet wound of spinal canal with the full/total/complete anatomical interruption of brain at the level of the XII thoracic vertebra. 24/III repeated neurologic examination/inspection (by neuropathologist of higher qualification). Lower paraplegia with apoflexia. After pricking and touches to the skin it does not perceive, but clearly perceives the energetic compression of skin fold for the shin, and also the compression of gastrocnemius muscles and feet, somewhat better on the right strut. Conclusion: the blind-end bullet wound of spinal cord with a deep, but partial violation of its conductivity. Is shown urgent operation/process. 25/III - laminectomy. Pointed bullet by dull end

sat in body of the XII thoracic vertebra; its tip in the form of pin projected between the posterior columns. Bullet is carefully extracted from the spinal cord on the wound course.

Light movements in the left foot appeared already next day. In 21/2 months paralysis of the right strut, movements in the left strut were reduced in all joints, but the muscle force in it is sharply weakened. Decrease in the skin sensitivity from the second lumbar on the third sacral segment inclusively. Knee and achilles reflexes as before are absent. Urination and defecation of normal ones.

Upon the first examination/inspection the neuropathologist was restricted to the investigation only of epicritical skin sensitivity and, after coming to light/detecting/exposing its loss, and having also taken into consideration the blind character/nature of the wound of spine, erroneously it concluded about the full/total/complete anatomical interruption of brain and the absence of readings to laminectomy.

The full/total/complete violation of conductivity was observed mainly with the wounds of the spinal cord. However, with the wounds of horse tail it was noted rarely (into 8.0-9.0o/o of all penetrating wounds of the lumbosacral division of spine). This can be explained by the following reasons.



Usually the unit of the rootlets of horse tail slipped off from the wounding shell. Therefore even with the wounds by its bullet either large/coarse fragment anatomical interruption or rough contusion underwent only the unit of the rootlets. Exception were the cases of the wounds of horse tail at the level of cone and immediately under it. Rootlets here encircle cone by the compact mass. With the penetrating wounds at this level the full/total/complete cross interruption of horse tail was observed more frequently than during the equalizations of the underlying divisions of horse tail.

The nerve fibers of rootlets, covered with the continuation of soft cerebral shell, possess larger stability to the mechanical action on them, than the filament of spinal cord. Therefore the interruption of rootlets was observed under the analogous conditions more thinly/less frequently than the interruption of the draw plates of spinal cord.

Syndrome of the full/total/complete transverse contamination of spinal cord.

For the characteristic of the severity of the damage of spinal

cord some clinicians applied the terms: "full/total/complete anatomical interruption of spinal cord" and "partial anatomical interruption of spinal cord", others - "complete transverse contamination of spinal cord" and the "partial transverse contamination of spinal cord".

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From the clinical point of view, latter/last two terms should be recognized more advisable.

As is known, in the literature to the Great Patriotic War term "full/total/complete anatomical interruption of spinal cord" applied with its peppered gap with the full/total/complete dissociation of central and peripheral cut; partial - with different degree of the destruction (strain, cut) of the unit of the diameter of spinal cord with the retention/preservation/maintaining of the anatomical continuity of the remaining unit, which was usually undergoing heavy contusion (Fig. 47 and 48).

But the experiment/experience of the Great Patriotic War showed that the full/total/complete transverse contamination of all nerve fibers of spinal cord (axons) can occur not only during the violation anatomically, i.e., seen by rule of thumb, continuity of brain, but

also with the full/total/complete cross necroses and its heavy contusions without the macroscopically visible in the first weeks after wound interruption and the disagreement of its ends (Fig. 46, 2).

Thus, with the bullet wounds of spinal cord occurred two types of the transverse contamination of all its nerve fibers. With one it was connected with the violation of the anatomical continuity of brain, with other - without the same. For the designation of the latter/last type of the interruption of the nerve guides of spinal cord the author (1943) proposed term axonal interruption. Like anatomical interruption, axonal interruption of spinal cord can be partial and full/total/complete. Many cases of the partial anatomical interruption of spinal cord were escorted/tracked by the axonal interruption of that unit of its diameter, that macroscopically retained its continuity. This mixed form of the interruption of spinal cord with the bullet wounds was observed most frequently.

In functional-prognostic sense the anatomical and axonal interruption of spinal cord it is completely equivalent: neither with that nor with other of any regeneration of nerve fibers it occurs and, therefore, the lost functions are not reduced. The liberation/excretion of the axonal interruption of spinal cord has not only theoretical interest, but also specific practical value.

The state of preservation of the anatomical continuity of spinal cord in the early period by no means does not eliminate its full/total/complete axonal interruption. Therefore neurosurgeon, after revealing/detecting on the operating table, with the clinical picture of the full/total/complete either heavy partial violation of the conductivity of spinal cord, continuity its or partial gap, must observe especial care in the post-operational prognosis. The its must not astonish fact that in the absence of the anatomical interruption of spinal cord surgical intervention brought to the casualty of no use.

Existence, together with the anatomical, the axonal interruption of spinal cord explains also the fairly often observed cases of disagreeing the diagnoses of clinician and anatomical pathologist. In the sharp/acute and early period the anatomical pathologist did not frequently find the anatomical interruption of spinal cord when he was diagnosed intravitaly by neuropathologist. For the neuropathologist the allowed by him error was frequently completely not expected.

In fact, after revealing/detecting the full/total/complete violation of the conductivity of brain, neuropathologist usually is diagnosed itself of anatomical interruption.



Fig. 47. Perforating bullet penetrating wound of the thoracic division of spine. the full/total/complete anatomical interruption of spinal cord. Fringing of stump. At the level of the interruption of brain solid cerebral shell is destroyed almost completely, was preserved its only ridge.

Preparation VHM No 1509.

(Artist T. V. Belyayeva.).

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Fig. 48. Blind-end fragmentation penetrating wound of spine at the level of IX thoracic vertebra.

Partial anatomical interruption of spinal cord; in the region of interruption will hit the ground large/coarse metallic fragment. The surface of the damaged sector of brain is impregnated with the blood.

Preparation VMM No 1155.

(Artist T. V. Balyayeva.).

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But the experiment/experience of the Great Patriotic War showed that, relying on data only of neurologic study, it frequently inflowed into the error. The neurologic method, undertaken by itself, with the clinical picture of the complete violation of the conductivity of the spinal cord tells only about the presence of the stable violation of conducting nerve impulses on the spinal cord. But the latter, as noted above, occurs not only with the anatomical, but also with its axonal interruption. Neuropathologist must consider both these possibilities and be limited to the diagnosis: the full/total/complete transverse -contamination of spinal cord, without predetermining a question about whether does lie/rest at the basis its gap of spinal cord with the disagreement of ends or

reproduction/multiplication with the interruption only of axons. Having only thoroughly compared neurologic data with the data of X-ray analytical and surgical examination/inspection, it sometimes can diagnose of the full/total/complete anatomical interruption of spinal cord.

Surgeon, operating in the early period and after revealing/detecting the absence of the violation of the anatomical continuity of spinal cord, usually diagnosed of contusion or partial interruption of spinal cord; whereas anatomical pathologist on the autopsy after 4-5 weeks frequently found in this case full/total/complete anatomical interruption. In the majority of the cases occurred, obviously, the axonal interruption of spinal cord, and to the time of operation spinal cord retained its macroscopic continuity.

Subsequently the crushed sector of spinal cord underwent decomposition/decay and resorption under the lipolytic action of cerebro-spinal fluid. As a result up to the moment/torque of opening appeared full/total/complete anatomical interruption. As an example can serve the following observation.

C. 20/I 1942 - the blind-end fragmentation wound of spine at the level of the VII thoracic vertebra with the full/total/complete



violation of the conductivity of spinal cord from the level of the sixth thoracic segment. Immediately after wound - loss of consciousness for 20-30 minutes; from the return of consciousness revealed/detected paralysis of lower extremities and deaf-mutism, which disappeared to the third day. Neurologic (27/I): lower flaccid paraplegia with the loss of reflexes and all forms/species of sensitivity from the sixth thoracic segment the delay of urine and chair/stool. X-ray analysis of spine the crushed break of awned extension and small arc of the VII thoracic vertebra. Large/coarse metallic fragment is arranged/located among the scrap of small arc, penetrating the posterior division of spinal canal at the level of the damaged vertebra. 30/I Laminectomy. Several fragments of the arc of the VII thoracic vertebra penetrated in the epidural space, and one of them was stuck into the solid cerebral shell. The large part of the metallic fragment the size/dimension 2x1.5x0.6 of cm was disposed of in the spinal canal, squeezing solid cerebral shell. after the extraction of bone fracture, which was stuck into the solid cerebral shell, appeared liquorrhea. After the dissection of the solid and arachnoidal shell: "... spinal cord is edematic, its surface vessels are [Tr. note: translation unknown; Russian is in "ipirovany"]. The consistency of its palpations is somewhat flaccid. In his left lateral column is determined the shallow wound, plotted/applied by bone fragment. Kray wounds slightly bulge out above the surface of brain". post-operation diagnosis: the partial

anatomical interruption of spinal cord. Prognosis, taking into consideration the lack of gross changes in the memory section of the brain, favorable.

Casualty it perished after 65 days. The improvement, which was being observed in it after the month after operation/process, consisted of the appearance of weak achilles reflexes, but also they subsequently disappeared. Simultaneously with the disappearance of achilles reflexes the upper level of damage/defeat began gradually to heave and up to the moment/torque of death of patient achieved the third thoracic segment. Data of the autopsy: "... at the level of the VII thoracic vertebra the substance of spinal cord is absent, its proximal and extremital ends are connect/joined together by strand of the soft cerebral shell. The spinal cord upwards to the level of the II thoracic vertebra and to the medullar cone is down edematic, its figure in in the cross section/cut is smoothed and indistinct. Anatomical diagnosis: the blind-end fragmentation wound of spine with the full/total/complete anatomical break of spinal cord at the level of the VII thoracic vertebra. Necrotically ulcerous cystitis, two-sided suppurative pyelitis. Lipoid infiltration and regeneration of the kidneys, liver. Extensive bedsores. Heavy cachexia".

The given observation can serve as illustration to the following positions/situations:

1. The state of preservation of the anatomical continuity of spinal cord in the sharp/acute and early period does not exclude the possibility of its full/total/complete axonal interruption.

2. Surgeon, seeing in these periods on operating table only insignificant partial anatomical interruption of spinal cord, must allow/assume possibility of axonal interruption of remaining unit of brain and therefore only with larger care it can place favorable post-operation prognosis.

3. The dispersed sector of brain when damage of soft cerebral shell is present, can in the course of time completely separated and, thus, partial anatomical interruption is changed by full/total/complete. By this is explained disagreement meanwhile that it saw surgeon on the operating table, and anatomical pathologist - on the sectional. A series/number of similar cases observed A. N. Bakulev.

The given observation can serve also as an example of the onset of edemas in the intermediate period and the very probable role of the toxins in their development. It also shows that with the clinical

picture of the full/total/complete violation of the conductivity of spinal cord more expediently to speak not about the full/total/complete anatomical interruption of spinal cord, but about the full/total/complete transverse contamination by its, without predetermining thereby of a question about whether does go the matter about the full/total/complete gap of spinal cord or only about the full/total/complete transverse contamination of its axons.

The syndrome of the full/total/complete transverse contamination of spinal cord (interruption of brain) presents the combination of the full/total/complete violation of its conductivity with a deep disorganization the reflector, vasomotor-trophic, perspiration liberation and visceral functions of the division of spinal cord down from the stricken area. From the manifestations of the violation of these functions great diagnostic value have the following symptoms.

Solid edema of the paralyzed divisions of body. One of the frequent manifestations of the damage/defeat of vascular-trophic innervation was solid edema of the paralyzed extremities. It was observed into 21.20/o of all wounds of spine with the damage of spinal cord. Higher numerals are published by some authors, for example, by V. A. Kislov (40.00/o). According to separate authors' data, solid edema was observed into 90.0-95.00/o of cases of the full/total/complete transverse contamination of spinal cord.

Edema usually appeared on the 3-4th day after wound and frequently was held to 3-4 weeks. Many considered it as the symptom of the extremely heavy damage of spinal cord, and some - as the most convincing symptom of the full/total/complete transverse contamination of spinal cord.

The onset of edema frequently was noted also in the later periods. The reason for these late edemas was the severe intoxication of the division of spinal cord down from the stricken area. As the sources of intoxication served the extensive bedsores, severe cystopyelites, restricted spinal suppurative meningitides, osteomyelitis of rump, etc. Late edemas it was necessary to differentiate with the occlusion of deep lymphatic vessels and with thrombophlebitides. Usually solid edema was of identical expressed on both halves body. Its asymmetric development more frequently was observed during the damages/defects of horse tail.

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With severe damages of thoracic and also lumbar-sacral division of spine edema more frequently began with the feet and gradually advanced in the proximal direction, being spread in the heavy cases

of damaging the spinal cord to the floor/~~sex~~ organs/controls and the lower divisions of body.

In the Great Patriotic War edema was observed repeatedly not only with the anatomical interruption with the disagreement of the ends of spinal cord, but also with the axonal interruption. With the anatomical interruption edema usually was expressed more sharply than with the axonal.

Solid edema of the paralyzed extremities rarely (into 7.00/o) was observed also upon the partial destruction of spinal cord, especially during the damages/defects of lower-thoracic division of its and lumbar-sacral thickening. However, in these cases it usually rarely achieved considerable degree and, if wound was not complicated, it disappeared during the next 1-2 weeks.

Thus, the experiment/experience of the great Patriotic War showed that solid edema of the paralyzed extremities is although the very important, nevertheless not completely reliable sign of the full/total/complete transverse destruction of spinal cord or horse tail.

An important symptom of the full/total/complete transverse contamination of spinal cord is early (on 2-4th day after wound)

appearance and progressive development of bedsores with the localization of foci of higher than the lumbosacral thickening. The same value has a development even within the next few days of hemorrhagic cystitis, and during the damages/defeats of lower-thoracic division and rapid development of general/common/total depletion (as a result of the violation of absorption from the intestine).

Is completely groundless the assertion of some authors, that the symptom of the full/total/complete transverse contamination of spinal cord is the perception of the breakaway of the paralyzed unit of the body at the moment of wound. The inquiry of many casualties showed that this perception can appear, also, during the relatively moderate/mild bullet damages/defeats of spinal cord. So/such is indemonstrable in this respect the fact that some casualties during the first days after wound perceived the paralyzed division of body as something alien, with it not belonging.

The individual authors perceived the proof of the full/total/complete transverse contamination of spinal cord in the fact that the level of the loss of sensitivity did not descend. But this is correct only for the late periods when the violations of sensitivity, caused by dynamic changes in the roof and lymph circulation, and also by additional stricken areas it is cranial from

the place of interruption, they undergo reverse development. In the sharp/acute or early period the utilization for this purpose of the inalterability of the upper level of the violations of sensitivity is incorrect, since reduction for its count of the reverse development of the violations, caused by the additional factors indicated, was observed, as a rule, and upon the full/total/complete transverse contaminations.

Very important data for the recognition of the full/total/complete transverse contamination of spinal cord (in particular, its gap) provided the X-ray analysis of spine and clinico-surgical analysis of wound.

Thus, on the basis of the experiment/experience of the Great Patriotic War the most important syndrome of the full/total/complete transverse contamination of brain it is possible to consider the following combination of symptoms: full/total/complete paraplegia, anesthesia, including the incapacity of casualty to perceive such rough stimulations as the energetic compression of fingers/pins, feet, gastrocnemius muscles, fold of skin, solid edema of the paralyzed extremities earlier and the irrepressible development of bedsores and heavy, in particular hemorrhagic ones, cystitides, and also radiographically adjustable the I and II types of the wounds of spine.



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Many casualties with the full/total/complete transverse contamination of spinal cord and, in particular, with its anatomical interruption perished on the field of battle. Thus, in 47.00/o those been killed on the field of battle from the penetrating wounds of spine and those subjected to autopsy was discovered the full/total/complete transverse contamination of spinal cord. The significant part of the casualties with the full/total/complete transverse contamination of the spinal cord died during the first days and in the weeks in the institutions of army and front line area and only small unit achieved the deep rear. The speed of the transport of these casualties and its conditions at different fronts and in different periods of war were also different. By this is explained difference in the numerals of the anatomical interruptions of spinal cord, published by the individual authors.

G. P. Kornyskiy (specialized army hospital, where casualties they entered early periods) observed it in 9.00/o of those wounded the spine with the presence of the symptoms of the damage of spinal cord, auto-in (in the period of the blockade of Leningrad both into the early periods of admission and with the prolonged stay of those

wounded in the hospitals) - in 9.50/o all of those wounded the spine with the cerebrospinal violations.

Syndrome of compression.

In the sharp/acute and early period the most frequent reasons for the compression of spinal cord and horse tail they were: the large/coarse wounding shells and the bone scrap, which penetrated in the area of spinal canal; thinner/less frequent - displaced vertebrae with the dislocation their, subdural and epidural hematomas. In the later periods the compression of spinal cord was most frequently caused by arachnoiditis, chronic pachymeningitis, callus. Were observed the cases of compression of spinal cord by epidural abscesses.

The compression of spinal cord by the foreign bodies, which penetrated in the area of the spinal canal, or by the displaced vertebra appeared at the moment of wound and carried stable character/nature. Sometimes it could be increased in connection with further displacement of the foreign body or vertebra, for example, with the transportation of casualty. The compression of spinal cord by hematomas appeared usually for the next hours after wound. By its characteristic feature was the increase of the intensity of symptoms for a period of several hours, thinner/less frequent than 1-2 days.

It more frequently carried temporary/time character/nature and in proportion to the resorption of the issuing from blood underwent more or less full/total/complete reverse development. The compression of spinal cord by arachnoidal cysts and intergrowth, epidural scars and by callus usually appeared not earlier than 4-5 weeks.

In view of the fact that the compression of spinal cord detained the reduction of the reversible changes in its nerve elements/cells, and under the prolonged influence it could convert these changes in those not reversed, it was basic neurologic reading to laminectomy.

As far as mechanism is concerned of the unfavorable effect of pressure on the spinal cord and its rootlets, then primary meaning in this respect was assigned to disorder of blood and lymph circulations in the constrained sector of spinal cord, and also to the violations of liquor circulation.

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The recognition of the compression of brain at the beginning of the Great Patriotic War in comparison with the First World War moved far forward. This progress was provided with improvement and widespread putting into practice of radiographic method, and also methods of determining the cross-country ability of the

sub-arachnoidal space of spinal cord. Both these of method were widely used in the elapsing war.

The leading role in the recognition of the compression of brain in the early period belonged to radiographic method, in the intermediate and the late - to determination of the cross-country ability of subarachnoidal space.

The presence in area of spinal canal more or less large/coarse metallic bodies, the large-splintered character/nature of the breaks of small arcs, joint extensions, bodies of vertebrae, the dislocations of the latter and the calluses served as basic positive radiographic indications for the compression of spinal cord. However, the absence of the enumerated radiographic signs as in the early, so especially in intermediate and late period was not considered as the eliminating compression. The latter was frequently conditioned on the processes, unattainable for the determination of the methods of simple X-ray analysis. In the sharp/acute and early period such processes are hematomas and edema of brain; in the later - arachnoidites and chronic pachymeningitis.

For the recognition of the compression of spinal cord extensively was used the determination of the cross-country ability of sub-arachnoidal space with the aid of the methods of Pussep

(strong bending of head to the chest and its containment in this position/situation during 30-40 seconds) and Kvekkenshtedt (compression of neck veins). As is known, at basis of both these methods lies/rests the difficulty of the outflow of the venous blood from the area of skull as a result of pressing of neck veins, in turn, of the leading to the increase intracranial pressure.

In the opinion of authors' majority, the method of Pussep gave more precise data than the method of Kvekkenshtedt.

Considerably thinner/less frequent for determining the cross-country ability of the sub-arachnoidal space of spinal cord was applied test/sample with the air and contrast X-ray analysis. Both these of method in the early and even in the intermediate period could not be widely applied, since their fulfillment required the sedentary position/situation of casualty.

The use/application of contrast roentgenography with the introduction to the sub-arachnoidal space of such substances as lipiodol, torotrast, podipin, was not obtained wide acceptance, also, in the later periods. The restrained relation to this method was explained by the fact that as indicated the observations of peacetime, and also during the war with the White Finns, if contrast substances not by boldnesses from the sub-arachnoidal space, they

frequently caused severe neuritides and arachnoidites of horse tail.

For determining the cross-country ability of sub-arachnoidal space was used also protein-cellular dissociation in the cerebro-spinal fluid, i.e., the high content in it of protein for the normal or slightly increased content of cellular elements/cells.

Protein-cellular dissociation, rapid drop in the pressure of cerebro-spinal fluid in proportion to its discharge, the absence of its increase with the tests/samples of Pussep and Kvekkenshtedt - most important symptoms of the blockade of sub-arachnoidal space and compression of brain. But all these symptoms as the indicators of blockade acquired the degree of authenticity only in the absence of large/coarse defect in solid spinal cord, and in the presence of it only during the isolation of defect from the sub-arachnoidal space - pia-arachnoidal intergrowth or by intergrowth between themselves of all three shells. However, in the presence of the open defect in the solid cerebral shell the cerebro-spinal fluid ensues/escapes/flows out through it into the epidural space.

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Under these conditions the pressure of cerebro-spinal fluid (usually low) in proportion to its discharge through the aspirating needle

little changes, but tests/samples of Pussep and Kvekkenshtedt by its noticeably do not raise. Therefore in the early period during the decision/solution of a question about the presence or in the absence of the blockade of sub-arachnoidal space the evaluation of the results, obtained with the lumbar puncture, requires care.

Experiment/experience simultaneously showed that the absence of indications, according by this of lumbar puncture, to the blockade of sub-arachnoidal space did not eliminate completely the compression of the spinal cord. The latter could be caused, for example, by the small bone or metallic fragment, which were incorporated in the brain or in the solid cerebral shell, sizes/dimensions of which, however, were insufficient in order to completely block subarachnoidal space.

In the intermediate and late period for the determination of the blockade of sub-arachnoidal space, together with the investigation of cerebro-spinal fluid, the observation of a change in its pressure and the results of the tests of Pussep and Kvekkenshtedt, was applied also the test/sample with the air. Was fulfilled it as follows. After the extraction of 10-15 cm<sup>3</sup> of spinal fluid/liquid through the lumbar puncture in the position/situation of patient sitting they introduced into the subarachnoidal space 10-20 cm<sup>3</sup> of air. As the indicators of blockade served the absence of the symptoms of the penetration of air into the area of skull (vertigo, headache, nausea,

etc.) and the appearance of the encircling the radicular pains at the level of blockade.

As the example to the usefulness of test/sample with the air can serve the following observation.

Ts. 28/II 1943 the tangential fragmentation penetrating wound of spine at the level of the V neck vertebra; contusion and compression of brain at the level of this vertebra with the the partial damage of its conductivity.

Immediately after wound arose a deep paresis of all four extremities, are more than upper ones, and the gross violations of sensitivity from the fourth neck segment. Consciousness it did not lose; the functions of pelvic organs/controls were not disturbed. Radiographic investigation came to light/detected/exposed only the break of the awned extension of the V neck vertebra. Wound was considered as nonpenetrating and not being subject to the operation/process of laminectomy. In the first weeks after wound was noted progressive improvement of both motor and sensitive function, especially in the right extremities and in the left lower. Subsequently the improvement was interrupted and was changed into the deterioration: again was increased weakness in the upper extremities, especially in the right hand.



In connection with the deterioration 1/IV it is converted into the Leningrad neuro-surgical institute. With admission-paralysis of left hand, average/mean severity of the paresis of right hand and of left leg and insignificant paresis of the right leg. To the left - anesthesia from the fourth neck segment on the third thoracic inclusively with further gradual illumination, and to the right - decrease in the sensitivity from the fifth neck segment to the latter/last sacral segments. X-ray analysis: the break of awned extension and small arc of the V neck vertebra. Lumbar puncture gave not completely convincing indications of the blockade of sub-arachnoidal space.

For the confirmation of the presence of blockade, and also for determining lower boundary its, taking into account character/nature of the disorder of skin sensitivity on the left half body, was produced test/sample with the air. After the extraction 15 cm<sup>3</sup> of cerebro-spinal fluid to patient, who was being located in the sedentary position/situation, it was introduced to 15 cm<sup>3</sup> of air. Immediately after the introduction of air appeared the pains, which were disseminated on the sixth neck rootlets, more intense to the right. The perceptions, which indicate the penetration of air into the sub-arachnoidal space of brain, it was not. Conclusion: the

bullet break of awned extension and small arc of the V neck vertebra; the contusion of the neck division of brain at the level of the IV-V neck vertebra; the compression of brain epiduritis. Is shown surgical intervention.

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18/IV Laminectomy (C<sub>4</sub>-C<sub>6</sub>). Small arc and awned extension of the V neck vertebra proved to be broken. After their removal/distance are discovered the ring-shaped sausage mode from Rubtsov changed yellow ligament, intimal connected with the solid cerebral shell. On the dissection of the latter the brain proved to be paler than in the norm; on its posterior surface passed the strongly expanded coiled veins. At the same level there were arachnoidal intergrowth after dissociation of which was begun the strong escape of cerebro-spinal fluid from that lying above the division of sub-arachnoidal space. within the next few days after operation/process rapidly were improved motor and sensitive functions. <sup>1 1/2</sup> ~~11/2~~ Months after operation/process it walks freely, without resorting to the aid of crutches or sticks. With right hand he writes, although with difficulty, in the left hand the active movements are sharply restricted.

In the absence of radiographic indications of the compression of

brain in the intermediate and late period as basis to the assumption about it served stopping the begun improvement or exchange by its deterioration. Appearance or progressive build-up/growth of radicular pains, especially with the damages/defeats of horse tail, also was considered as symptoms, it was eighth suspicious to their insipient compression. For the timely recognition of compression in the intermediate and late period in all suspicious cases neuropathologists' majority considered necessary repeated checkout lumbar punctures for explaining the cross-country ability of sub-arachnoidal space.

During the partial violations of the conductivity of spinal cord, and also during the partial damages of horse tail in the sharp/acute and early period elimination of compression when the full/total/complete blockade of sub-arachnoidal space is present, usually gave relatively best results, than with the partial blockade. On the contrary, in the late periods the post-operational results with the full/total/complete blockade were more badly than with the partial.

This fact can be explained by the following reasons. The prolonged compression of brain led to finally the death of the nerve fibers of spinal cord and its rootlets. The more lately is operated casualty, the more development they achieved change in the shells

(adhesive arachnoidites, pachymeningitis) and they became less removed.

Perineo-anal radicular syndrome of position/situation.

Soviet neuropathologists' experience in the elapsing war enriched clinic of the bullet damages/defects of spinal cord by the series/number of new symptoms. From a number there is their theoretical and specific practical interest in perineo-anal radicular syndrome of position/situation. The essence of syndrome consists of the extremely characteristic combination of the painful and vesical disorders, which are amplified in the specific positions/situations of casualty. Syndrome was observed only with the blind-end bullet less frequently large-splintered penetrating wounds of spine in the region of horse tail with the subdural disposition of foreign body.

Pains were perceived by that wounded mainly or exclusively only in perineo-anal region. They were usually bilateral and they had burning character/nature. Against the background of permanent pains was observed their reinforcing in the form of the attacks/seizures/paroxysms when they stopped according to of patients, by "completely by those not borne".

Cough, sneezing/popping, physical stresses as, for example, with

the report/event of the defecation and urination, always hindered/hampered, considerably amplified pains. The symptom of "liquor jerk/impulse" was constant and as a rule, it was expressed sharply.

But is especially characteristic for the pains of those called by bullet, which is located in the sac of solid spinal cord, their reinforcing in semivertical or vertical position of patient and, on the contrary, remission/abatement or even disappearance in the position/situation lying/resting, especially on the stomach.

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Reinforcing of pains in the vertical position riveted to the bed even of those casualties who were capable were capable of walking. "To go into the restroom and to be wet standing, and also evacuate - for me suffering", declared such patients. The same patients noted that the emptying of the bladder in the position/situation standing proved to be that more hindered/hampered than in the position/situation lying/resting.

In the vertical and semivertical position/situation, and also during the cough, the sneezing/popping, straining, compression of neck veins to the pains in perineo-anal region frequently were

mixed/added the perceptions of pressure and "pressure on the bottom", on the bottom of a small pelvis and on the perineum, and also the extremely painful perceptions of compression or, on the contrary, the springings-away into the region of posterior passage and root of floor/sex term, the false urges for the urination and the defecation. Latter/last perceptions drew together these pains with tabetic vesical and rectal crises.

Perineo-anal syndrome appeared usually not immediately after wound, but through several days, sometimes through  $1\frac{1}{2}$  ~~11~~/~~2~~-3 weeks. The heavier the damage of horse tail or spinal cord (but without full/total/complete disruption of conductivity), the later it appeared. After arising, this syndrome usually grew on in its intensity. After the removal/distance of bullet it disappeared first almost suddenly, then gradually.

Differential-diagnostic value of perineo-anal syndrome with blind wounds of spine at the level of horse tail is very great. Its presence testifies about the determination of bullet in the subdural space. With the localization of bullet in the epidural space the syndrome, as a rule, was absent.

Perineo-anal radicular syndrome of position/situation made it possible to more precisely distinguish two these of the type of

wounds, than X-ray analysis. Following history of disease/sickness/illness/malady are characteristic for both localizations of bullet.

I. 21/VIII 1943 the blind-end penetrating bullet wound of the lumbar division of the spine. During the same day in <sup>MSB</sup> ~~ash~~ the dissection of wound canal and laminectomy of the II-III-IV lumbar vertebra. Are discovered and removed scrap of small arc of the III lumbar vertebra, defect in the solid cerebral shell was not discovered. 1/IX is radiographically established/installed "the absence of awned extensions and arcs of the II-III-IV lumbar vertebra after laminectomy. At the level of 1 sacral vertebra in the region of the osteitic extension is determined foreign body-bullet".

Neurologic: deep lower paraparesis. Decrease is more skin than the sensitivity from the first lumbar to second sacral segment inclusively and anesthesia in the region of latter/last three sacral segments. Paradoxical irretention of urine. To 15/IX developed typical perineo-anal syndrome. Sharp pains were perceived by the casualty around posterior passage, in the floor/sex member, in the perineum and over the posterior surface of the right thigh. They were amplified with lying on the spine, during the cough, the sneezing/popping and in the position/situation with the raised upper section of the body and abated with the position/situation of casualty on the stomach. The symptom of liquor jerk/impulse was

expressed sharply, in this case the casualty tested/experienced perception, "accurately perineum and posterior passage they bulge out outside".

Diagnosis: Blind wound of horse tail with the disposition of bullet in the lower division of the sack of solid cerebral shell. Diagnosis was confirmed with repeated laminectomy.

A. 4/II 1942 the blind-end bullet penetrating wound of the lumbar division of spine at the level of the IV lumbar vertebra foreign body (bullet, turned by sharp and downward) is arranged/located in the spinal canal on the level of body of the I sacral vertebra almost along the center line. Neurologic (13/II): a deep paresis of the right leg and moderate-left with the loss of reflexes. On the right foot - weakening sensitivity from the third lumbar segment and losses of the first sacral. On the left leg - weakening from the fifth lumbar segment. Pains insignificant, perceived predominantly in the right strut, from the position/situation of casualty in the bed do not depend; cough and their sneezing/popping do not amplify the symptom of liquor jerk/impulse negative. Conclusion: the blind-end bullet wound of spinal canal with the epidural disposition of bullet. Diagnosis was confirmed with laminectomy.



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Pathogenesis of perineo-anal root syndrome of position/situation following. Bullet, which is located in the sack of solid cerebral shell, is capable, depending on the position/situation of body, of being displaced. In the vertical or approaching it position/situation of body it by gravitational force is omitted into the end of the sack and increases pressure on the latter/last sacral rootlets, concentrated here in the very restricted sector. In this displacement of bullet downward and at reinforcing of the pressure, produced by it to the latter/last sacral rootlets, and lies/rests the reason for the increase of pains, appearance of perception of compression and expansion in the region of posterior passage, perineum and in the floor/sex member, and also reinforcing of the difficulty of urination in the vertical and semivertical position/situation of the body of casualty. From the point of view of the displacing activity of liquor wave to the bullet becomes clear the absence of reinforcing root pains (symptom of liquor push) with its epidural localization. With this localization liquor wave, slipping over the internal surface of the sack of solid cerebral shell, cannot displace bullet.

Neurologic characteristic of the bullet wounds of the basic divisions of spine and spinal cord <sup>1</sup>.

FOOTNOTE <sup>1</sup>. A comparative frequency and the character/nature of neurologic violations with the bullet wounds of spine are given in chapter V. Here is given the characteristic only of those damages/defeats of spine during which occurred neurologic violations. ENDFOOTNOTE.

Is given below on the basis of the experiment/experience of World War II the compressed characteristic of the clinical picture mainly of the sharp/acute and early period of the wounds of the basic divisions of spine.

Upper-neck division (I-IV neck vertebra). Immediately after wound frequently the loss of consciousness, sometimes vomiting. From a number of those wounded this division of spine survive only the obtained relatively moderate/mild damages/defeats of spinal cord. Casualties with the heavy damages of spinal cord produce extremely heavy impression as a result of the immobility as a result of paresis or paralysis of all four extremities, deep disorders of respiration, cyanosis, difficulty of speech, and sometimes also ingestion.

In the sharp/acute period are frequent the symptoms from the side of brain stem: the nonuniformity of pupils, the weakness of face musculature, nystagmus, slowing of pulse (to 40-30-25 shocks per minute), sharp drop in the arterial pressure, hypothermia, less frequent - hyperthermy (39-40°). Coughing reflex is frequently lost, the expectoration of mucus is difficult or is impossible.

Paresis or paralysis of all four extremities initially more frequently has flaccid character/nature, but in the lower extremities it is comparatively rapidly changed by spastic. The flaccid character/nature of paralysis or paresis of upper extremities is held longer.

The disorders of sensitivity sometimes are spread also to the posterior divisions of face (due to the spinal rootlets or the nucleus/kernel of trigeminal nerve). During the damage of spinous processes or ear for the separate casualties stably by that disrupted can remain musculoarticular feeling. Are frequent intense root pains in neck-postcranial region and forced position/situation of head - inclination/slope forward or to the side.

The disorder of the functions of pelvic organs/controls usually stably; in particular, comparatively rapidly is reduced the automatic emptying of the bladder. Severe cystitides, urosepsis are observed as an exception. Bedsores frequently are absent or rapidly heal. Can appear Claude Bernara-Gorne's one-sided or bilateral syndrome. Usually it is not stable. Exclusion were the cases when it was connected with the damage of frontier sympathetic shaft.

Rarely, as with the wounds of lower-neck division of spine, are observed the violations of the sonority of voice as a result of the associated damage/defeat of lower guttural nerve.

The overwhelming majority of casualties, including with the relatively moderate/mild damages/defeats of spinal cord, perishes. In those survived the first several critical days subsequently the lost functions usually are reduced well.

Lower-neck division (V-VII neck vertebra). During the heavy damages/defeats immediately after wound into 20.0-25.0% is observed the loss of consciousness. Usually it is not prolonged. Chest is sealed, interfin gaps/intervals are expanded. The respiratory movements of chest are sharply weakened, the inspiratory movements of

diaphragm/midriff and contraction/abbreviation of additional neck respiratory/breathing muscles are intensified. Coughing reflex is weakened or lost, the expectoration of mucus is hindered/hampered or is impossible. Arterial pressure is lowered/reduced, it is sometimes considerable; pulse is frequently delayed, the temperature of body is lowered/reduced. Frequently - different degree Claude Bernard-Gorne's one-sided or two-way symptom.

Paresis or paralysis of upper extremities is initially flaccid. Subsequently it either remains flaccid with the atrophy of muscles, especially fine/small muscles of hands, or, it is more frequently, acquires the mixed character/nature. Paralysis or paresis of lower extremities, initially also usually flaccid, is comparatively rapidly changed by spastic.

The functions of pelvic organs/controls in the sharp/acute period, as a rule, are disturbed/detuned, but their disorder does not carry so stable a character/nature as with the lower localizations of wound. In particular, during the gross violation of active control of the report/event of urination, even during comparatively heavy damages/defeats of brain, the automatic emptying of bubble is reduced rapidly - frequently through 1-2 weeks.

Upper boundary of the disorder of conductor sensitivity

initially corresponds approximately/exemplarily to collar bone. Subsequently it descends with respect to the upper level of stable focus in the spinal cord. In the residual period against the background of the conductor violation of sensitivity, while sometimes and without this, its disorder on the upper extremities can carry the dissociated character/nature. In the cases of the partial violation of the conductivity of brain approximately/exemplarily in 10.00/o of casualties, as a result of the implication of the intravertebral division of neck roots in the arachnoidal joints and the epidural scars or the associated damage of their extravertebral division, and also the brachial plexus, can be observed cruel pains in one or in both upper extremities. During the damage/defeat at the level of the V neck or I thoracic vertebra as a result of implication in the suffering of the connective branches of frontier sympathetic shaft or stellate ganglion root pains rarely can acquire causalgic character/nature.

Severe cystitides and bedsores are observed comparatively rarely and they are developed late. Are described the individual cases of tetanic spasms.

During the heavy damages/defeats many casualties perish in the early period from hypo-static or paralytic pneumonia.

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Vital prognosis in those survived the first 2 weeks, with exception of the cases with the full/total/complete violation of the conductivity of spinal cord, on the whole favorable. Functional prognosis in the heavy cases, in particular in the relation to the reduction of the functions of upper extremities, serious.

Upper-thoracic division (I-IV thoracic vertebra). Even during the heavy damages/defeats the loss of consciousness is observed comparatively rarely. In the mild cases motor disorders are noted only in the lower extremities, in the heavy ones - usually and in the upper ones, sometimes in combination with Claude Bernard-Gorné's syndrome. In the upper extremities motor violations usually disappear already within the next few days. During the partial violations of the conductivity of brain tendinous-periosteal reflexes on the lower extremities even if are lost, then for the short period. By equal mode already from the first days after wound can appear pathological stop reflexes. During the heavy damages/defeats in the early period paralysis, as a rule, has flaccid character/nature, but even upon the rough transverse contaminations of brain its gradual transition into the spastic begins through 3-4 weeks.

During the first days the casualties frequently test/experience

in the upper extremities of the various kinds of paresthesia (numbness, running goose pimples, etc.). But the stable violations of sensitivity in them are absent or occur expressed in the form of the ridge over the inside surface of shoulder. As a result of multiple failure of frontier sympathetic shaft or its ganglia/nodes can appear, especially in the intermediate period, diffuse sympathetic pains in the similar/analogous upper extremity and the half neck, less frequent than the head.

In casualties with the heavy damage/defeat of spinal cord the respiration as a result of paralysis of interfin muscles is hindered/hampered, interfin gaps/intervals are expanded, the contractions/abbreviations of diaphragm/midriff intensified.

In the cases of the simultaneous wound of light ones or accumulation the blood in the pleural area of the disorder of respiration are complicated due to the latter. In the units of the casualties of the disorder of breathing caused by the wound of lungs and pleurae, they can come forward to the foreground. The frequent complication of the wound of this division of spine are pneumonia. During the first days after wound frequently are observed the serious disorders of heart activity, a drop in the arterial pressure of the blood.



The disorders of the function of pelvic organs/controls more frequently are expressed more sharply than during the damages/defeats of the neck division of spine, and the transition of the full/total/complete delay of urine into the automatic emptying of the bladder is accomplished more slowly. If is not undertaken the imposition of urinary bladder fistula, then as a result of the prolonged catheterization frequently are developed severe cystitides and cystopyelitis. In the heavy cases with the insufficiently well organized departure/attendance appear the bedsores, but it is rarely earlier  $1\frac{1}{2}$ -2 weeks.

Mesothoracic division (V-VII thoracic vertebra). Even during the heavy damages/defeats the loss of consciousness is observed rarely (into 5.0-6.0o/o). The disorders of respiration, if the damage/defeat of spinal cord is not escorted/tracked by the simultaneous wound of the lung or by the considerable outflow of the blood into the area of pleurae, less heavy than during the damage/defeat of that lying it is above the division of spine. During any heavy damages of brain paralysis of lower extremities for a long time remains flaccid.

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But even upon the full/total/complete transverse contamination of brain, if patient remains into the living in the course of 2-3

months, tendinous-periosteal reflexes to a certain degree they are reduced, and also appear pathological stop reflexes.

The disorders of sensitivity completely depend on the severity of the damage of spinal cord. During the first days and in the weeks of the disorder of motor and sensitive functions on both halves body more or are less uniform. But also in the residual conditions are usual parapareses, sometimes with the preponderance of paretic phenomena on one side; the typical syndrome of Brown-Sekar is observed rarely.

The disorders of the functions of pelvic organs/controls are frequent, and the delay of urine - is firm. The reduction of the reflector emptying of the bladder during the heavy damages/defeats attacks/advances late - in 1-2 months. Therefore is required prolonged catheterization or imposition of urinary bladder fistula. Complications from the side of urinary system more frequent and are more firm than with the wounds of the overlying divisions of spine.

In the sharp/acute period rarely can be observed the syndrome of sharp/acute stomach. Are frequent the cases of the heavy general/common/total depletion, connected with the violation of the secretory, motor and absorptive function of intestine.

Lower-thoracic division (IX-XII thoracic vertebra). The loss of creation, even during the heavy damages/defeats, is observed as an exception. Paralysis or paresis of lower extremities long remains flaccid; in the heavy cases the reflexes usually are not reduced. Relatively frequently appear (into 3.00/o of heavy damages/defeats) the syndrome of sharp/acute stomach, and also vasomotor-trophic hematuria, heavy adynamia as a result of the damage of the adrenal glands or their nerves and spinal cord centers.

The damage of the function of pelvic organs/controls are observed, as a rule. They usually are evinced by the delay of urine and feces. With wounds of the XII thoracic vertebra, with which frequently is damaged the sympathetic center of the internal sphincter of the bladder, the original delay of urine only 2-3 weeks is after changed by irretention. However, sometimes the irretention of urine appears from the first days after wound and carries the character/nature of actual irretention. As a result of the violation of the trophic system of the bladder cystitis frequently acquires hemorrhagic or ulcerous character/nature. Bedsores appear they early and frequently detect inclination to the rapid development.

Upper-lumbar division (I-III lumbar vertebra). It is damaged epicone, cone and rootlets of the initial division of horse tail. Paralysis of lower extremities, as a rule, flaccid and initially

symmetrical. Flaccid character/nature it retains also subsequently. Less frequent, during comparatively weak damages of spinal cord, one or the other tendinous reflexes subsequently to a certain degree are reduced. Pathological reflexes in the sharp/acute and early period are absent. In the later periods of the partial damage of brain, complicated by arachnoiditis or additional foci, which are localized it is higher than the basic stricken area, rarely can be observed pathological stop reflexes, but they usually are weakly expressed.

Upper boundary of the violation of skin sensitivity in the sharp/acute period usually passes on the pupart ligament or somewhat above. As a result of the simultaneous damage/defeat of the rootlets, which pass past the cone, the typical for damaging the cone violation of sensitivity in the form of "breeches" in the sharp/acute and early period is observed exclusively rarely, but also in the later periods it is observed not frequently (into 3.0-4.0o/o), besides only with the nonpenetrating wounds.

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The damage of the function of pelvic organs/controls are permanent in the majority of the cases heavy. As a result of paralysis of detrusor the delay of urine is especially firm. Is observed the paradoxical irretention of urine. In the heavy cases of

the wound of brain as a result of the violation of the trophic system of the bladder cystitis appears it early and frequently acquires ulcerous or hemorrhagic character/nature. Bedsores appear on the 3-5th day and rapidly and irrepressible they are developed. Appearing on the soil of cystitides and bedsores septic conditions in many instances are the reason for the fatal results.

With the wounds of this division of spine also sometimes are observed the syndrome of sharp/acute stomach, disorder of general/common/total nourishment, heavy adynamia. Suprarenal pathogenesis of the latter is confirmed not only by the dark (bronze) stain/staining of skin integuments and by low arterial pressure in these casualties, but sometimes and by data of the pathomorphological study of the adrenal glands. Observed with the wounds of upper-lumbar division of spine hematuria is connected not only with the violation of vasomotor-trophic innervation of kidneys, but also with their contusion and wound.

In the intermediate and in the late periods in the cases of the partial damage of rootlets of the initial division of horse tail or their implication in the arachnoidal intergrowth can arise the severe pains in the lower extremities. In the residual conditions during the relatively good reduction of motor functions can remain only the stable violations of urination, defecation and floor/sex function.

Lower-lumbar and upper-sacral division (IV-V lumbar and I-II sacral vertebra). With the nonpenetrating wounds paralyses are observed rarely, more frequently occur paresis. In the sharp/acute and early period considerable motor violations usually occur in all divisions of lower extremities; in further-predominantly in the extremital ones. With those penetrating and are especially with the perforating wounds of spine frequent the combinations of root and cone damages/defeats.

In third of cases motor and sensitive fallouts already from the first days can be expressed unevenly, predominating on one of the extremities. Asymmetry of functional fallouts subsequently usually grows on. In residual conditions the functions of one extremity are frequently reduced completely or almost completely, and another they remain deeply disrupted. Approximately/exemplarily into 3.50/o are observed the dissociated syndromes: the isolated/insulated or preferred fallout only of motor or only sensitive function. Patellar reflexes frequently are retained, achilles more frequently are lost.

The characteristic feature of the wounds of this division of spine, which especially penetrate, are root pains. More than in the half the cases they appear immediately after wound. But also when

they initially are absent, they frequently appear subsequently in connection with the development of arachnoiditis or pachymeningitis externa. Pains, especially during submembrane hemorrhages, and also during the determination of foreign bodies in the area of the sack of solid cerebral shell, can achieve extreme intensity. During the determination of bullet in the area of sack they sharply are amplified under the effect of the cough, the sneezing/popping, in the vertical position of casualty.

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Frequently pains acquire causalgic hue. In the majority of these cases, apparently is multiple failure of the lumbar division of frontier sympathetic shaft. Pains are absent only with the full/total/complete cross interruptions of horse tail.

The disorders of the function of the bladder in the early period are expressed in the delay of urine. With the full/total/complete interruptions of tail the delay of urine carries stable character/nature. Comparatively frequently there is the paradoxical irretention of urine (16.0-18.0o/o). In the cases of prolonged catheterization the delay of the urine of limber is changed by irretention as a result of the gradual loss by the internal sphincter of its tone. But generally the severity of the damage of the function

of pelvic organs/controls is less it is expressed than during the damages/defeats of lumbosacral thickening. Bedsores do not usually achieve this development and dissemination as during the damages/defeats of this thickening.

The differential diagnosis between the damage/defeat of cone and horse tail during the bullet damages/defeats of lumbar-sacral division of spine is very difficult. Is explained this first of all by that fact that in the suppressing number of penetrating wounds of this division of spine, independent of the level of wound, one way or another they are damaged both rootlets of horse tail and cone. The experiment/experience of World War II showed that the proposed by Bing scheme for the differentiation of the damages/defeats of these divisions, based on the study of the diseases of brain and horse tail (neoplasm of cone and tail, hematomyelia, arachnoidites), was barely suitable for the bullet damages/defeats of these education.

Wounds of latter/last three sacral vertebrae. Are damaged the epidural cuts of latter/last three sacral rootlets. In the sharp/acute and early period can be observed the paresis of lower extremities as a result of the jolt of horse tail. Basic symptom is the disorder of the functions of pelvic organs/controls. As a result of the defile of canal in this division of rump and intimate mutual disposition of rootlets with the penetrating wounds they frequently are interrupted, and the disorders of pelvic organs/controls acquire stable character/nature.



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Chapter V.

DIAGNOSIS OF BULLET WOUNDS AND DAMAGES OF SPINE AND SPINAL CORD.

Surgical diagnosis of bullet wounds and damages of spine and spinal cord.

Candidate of medical sciences docent D. G. Gol'dver and doctor of medical sciences G. P. Kornyskiy.

The diagnosis of the bullet wounds of spincal column and spinal cord was based on the surgical, neurologic and x-ray examination of casualties.

Surgical investigation was frequently very difficult.

With the heavy wounds of spine and spinal cord in the sharp/acute period the casualties sometimes entered the condition of traumatic shock. In similar cases clinical picture was typical for the latter: the pale or earthen color of face; frequent, small pulse, unresponsiveness, apathetic relation to that surrounding, less

frequent - condition of light euphoria. During the investigation of the wounded, located in the condition shock, even paralytic phenomena could slip off from the attention of the doctor in attendance. After the liquidation of shock or in the absence its obtained heavy wounds of spine and spinal cord frequently did not present complaints, quietly expecting its turn in the sorting, receiving rest or surgical dressing. With the inspection of this casualty attention is drawn to the presence more or less disseminated flaccid paralysis of extremities (depending on the level of wound); stomach was usually inflated as a result of the accumulation of gases in the paralyzed intestine, it was more rarely was sucked. Against this background were secreted the outlines of the bladder, overfilled by urine, if it did not empty by catheter in the preceding stage evacuations. The palpation of stomach, with rare exception, was painless.

With the wounds of spine in the neck or upper-thoracic division the casualties complained about the difficulty of respiration.

With the less severe isolated nonpenetrating wounds of spine the general condition of casualty was considerably better. The phenomena of traumatic shock were observed only as exclusion, although the paralytic phenomena could be similar to those described above. In this case the casualties frequently complained on the pain in the region of damaging the spine.

During damage or compression of roots (especially in the cases of blind-end wound) local pains in the region of spine and projection pains in the extremities or the body could achieve sharp intensity. Casualties became agitated, continuously they moaned, requiring renderings to urgent aid.

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With the inspection of spine, if wound was located far from it, usually could not be noted any noticeable strain, only rarely it was possible to establish the light swelling (hematoma) at the level of wound. However, during the determination of wound near the spine this swelling almost always occurred.

Any expressed kyphosis at the level of wound, in contrast to the compression breaks during the closed damages, was encountered extremely rarely. The palpation of spine as axial load, was little painful. During the palpation in the cases of the breaks of awned extensions or small arcs frequently was noted the crunch and pathological mobility at the level of break. If localization of wound and sharply pronounced neurologic violations even without that testified about the level of the damage of spine, then surgeons'

majority rejected palpation or percussion of spine, attempting to avoid the supplementary traumatization both the spine, and the contained spinal canal.

In similar cases the X-ray analysis more precisely formulated localization and character/nature of the damage of spine. With the lighter bullet wounds of spine without the expressed neurologic violations or with the blurred manifestations of the damage of the contained spinal canal the surgical investigation of spine was wider. In this case they investigated not only local sickliness with the palpation or the axial load on the spine, but also the possible mobility of spine and its boundary. In this case, as a rule, in the cases of the break of cross extensions the sickliness was amplified with the flexure to the side of the damaged extensions; whereas with the break of awned extensions proved to be morbid the flexure forward or back. With the passive flexure of lower extremities in the hip joint appeared or was amplified the pain at the level of the damaged vertebra.

In histories of disease/sickness/illness/malady it was not encountered indications of reinforcing of pain at a pressure on the appropriate edge/fin in the cases of the bullet breaks of the thoracic division of spine.

With the bullet break of the cross extensions of lumbar vertebrae the raising of the driven away in the knee joints lower extremities, i.e., the breakaway of feet from the bed, proved to be impossible or sharply morbid, as this is observed with the so-called separating breaks of cross extensions in the cases of the closed damage of spine. The longitudinal muscles of back in this case, if wound proved to be not near the place of break, were usually strained.

During the damages of the neck division of spine the movements by head were very restricted and morbid. In this case the casualty, sparing the neck division of spine, frequently supported head with hands. The muscles of neck in similar cases proved to be strained, and posterior longitudinal muscles stretched as strings.

Most important data for the establishment of character/nature and level of the wound of spine could be obtained during the inspection of wound and the possible analysis of the course of wound canal.

With the extensive wounds, which were being arranged/located from behind along the center line or near from it, frequently it suffices it was sufficient to breed the edge of wound in order to establish the break of spine; in such cases on the day of wound it

was possible to see bone fragments, and sometimes also foreign bodies.

The reliable fact, which confirms the penetrating wound of spine, was liquorrhea which could be established on the accumulation of cerebro-spinal fluid on the day of wound and on the admission of the new portions of fluid/liquid after the desiccation of the bottom of wound.

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With the wounds with the small zone of damage (with the narrow input or outlet), even if wound was arranged/located along the posterior surface of body near from the center line, investigation was extremely difficult. In accordance with the general-surgical principles the doctors usually abstained from probing of wound; only sometimes surgeons resorted to the cautious probing, doubtless which helped to compose preliminary representation about the direction of wound canal, and at the same time about the possible damage of spine.

During the disposition of wound at the more or less considerable distance from the spine (on the lateral surface of neck or body, in the buttock field, etc.) even probing could not lighten the determination of the direction of wound canal. In similar cases with

the perforating wounds it remained to only mentally reproduce wound canal via the comparison of input and outlet. However, with the blind-end wounds even mental representation about the direction of wound canal could be composed only after X-ray analysis via the comparison of inlet and localization of foreign body. But also under these conditions was always necessary to consider that the wound canal can be very complex, and wound itself - ricocheting within the body, especially with the long oblique wound canals, passing through entire body and crossing/intersecting on its route/path different tissues. During the determination of the direction of wound canal and its relation to the spine it was always necessary to also take into consideration the position/situation (pose) of casualty at the moment of wound, about which the majority of casualties it could give reliable information.

Incidentally in wounded is clarified also the character/nature of bombardment at the moment of wound. In the majority of the cases the casualties could report, under what facts they were wounded and the probability of the wounding shell (bullet, fragments of mine, shell, etc.), although sometimes the casualty could not give necessary information, since combat situation could be very complex. Nevertheless it was always desirably explain the wounding shell (especially in the cases of tangential and perforating wounds), taking into account the special features/peculiarities of the

character/nature of the damage of spine and course of wound depending on the form/species of the wounding shell.

Thus, surgical investigation, in particular, the possible analysis of the course of wound canal, helped to come to light/detect/expose both the wound of spine and paravertebral wound and in a number of cases it more precisely formulated not only the level of wound, but also its character/nature.

Special importance the surgical investigation of wounded, in particular, an analysis of the direction of wound canal, had with the combined wounds of the spine when by one wounding shell were simultaneously damaged spine and other organs/controls or systems.

Experiment/experience showed that during the heavy damages of spinal cord the wound of cavitory organs/controls, in particular, the organs/controls of abdominal area, was frequently masked with paralytic phenomena. In particular, the difficulty of respiration, meteorism, delay of urination and defecation, hematuria against the background of the heavy general condition of casualty could occur, also, without the damage of the corresponding organs/controls of abdominal area, small pelvis or retroperitoneal organs/controls. In similar cases the analysis of the direction of wound canal helped to come to light/detect/expose the possible damage of the corresponding



organs/controls. In the doubtful cases, even if x-ray examination did not facilitate the accomplishment of mission, it was necessary to resort even to explorative operation/process, which in this case was converted into the closing link of the surgical investigation of casualty.

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To determine the penetrating wound of thoracic area was usually more easily on the presence of open or closed pneumothorax or hemothorax.

Somewhat simpler was surgical investigation with the associated wound of the spine when by several wounding shells were simultaneously damaged spine and another organs and tissues. In similar cases the careful inspection of casualty and the purposeful investigations helped to come to light/detect/expose damage, together with the spine, and other organs/controls. In this case it was necessary to consider also point to the form/species wounds and violations of integuments, which seem now and then abrasions.

The experiment/experience of war showed that the surgical investigation of casualty, in particular, wounds with the possible study of the direction of wound canals, must be especially careful with the heavy wounds of spine with the full/total/complete violation

of the conductivity of spinal cord at the more or less high level. Insufficient attention in similar cases to the point bullet or fragmentation wounds in the body or extremities sometimes unexpectedly proved to be fraught such terrible complications of early period as peritonitis, anaerobic infection, etc.

Is difficult to overestimate role surgical of investigation with the multiple wounds of the spine when the latter is simultaneously damaged at different levels by several wounding shells. With such wounds the more or less heavy damage of spinal cord, arranged/located caudally, it could remain unnoticed during the neurologic investigation, being closed over with the syndrome of the damage/defeat of spinal cord at the higher level. Only with the careful surgical investigation of all, even point ones, wounds it was possible to avoid diagnostic error.

The surgical investigation of those wounded into the spine in the intermediate and late period had as a goal to come to light/detect/expose not only presence and character/nature of the damage of spine, but also different complications of this wound. Surgical investigation in combination with the x-ray, and also microbiological and clinical laboratory examination helped to in proper time come to light/detect/expose wound infection, anaerobic infection, osteomyelitis, phlegmons, flows and other complications,

connected with the infection wounds, and also complications from the side of the organs/controls of chest, abdominal area, neck, extremities with the combined and associated wounds.

With the diagnosis of different complications in casualties with the damage of spine and spinal cord it is necessary to consider two special features/peculiarities in their course: 1) the fallout of sensitivity in the segments, arranged/located down from the level of the damage of spinal cord, it turned off/disconnected in casualties the signals of pain and thereby it could hinder/hamper the early development/detection of complication from the side of one or the other organ/control; 2) different complications in such casualties frequently flowed/occurred/lasted extremely limply (it is torpid) and by the fact shaded the clinical picture of the emergent complication.

All this complicated the procedure of the surgical study of casualties and required from the doctors in attendance of the purposeful investigation along the systems taking into account the special features/peculiarities indicated in the course of complications.

One should emphasize that during the analysis of the wound of spine and spinal cord the surgical investigation tightly was interwoven with the neurologic and the roentgenological. All these

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ways of experiment in combination with the data, obtained with the microbiological, the clinical laboratory, and sometimes also electrophysiological investigation, conditioned complete representation about the character/nature of the wound of spine and spinal cord and by the fact was determined neurosurgeon's therapeutic and evacuation tactics.

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Neurologic diagnosis of bullet wounds and damages of spinal cord.

Corresponding member of the Academy of medical Sciences of the USSR  
Honored Scientist professor I. Ya. Razdol'skiy.

In each specific case of the bullet wound of spinal cord the neuropathologist and neurosurgeon must maximally rapidly and accurately establish: 1) are such mechanism, severity, localization and character/nature of the damage of spine and spinal cord; 2) which most probable issue of wound; 3) the most most advisable method of treatment and, in particular, to solve a question about presence or absence of readings and periods of laminectomy.

Severity of damage of brain. After 1 $\frac{1}{2}$ -3 the weeks after the wound when the phenomena of cerebrospinal shock disappear and the reversible changes in the nerve cells and the filaments to a certain degree are reduced, the recognition of the severity of the damage/defeat of brain does not present difficulties. But in the first 1-2 weeks when to the stable fallouts of functions, caused by the death of nerve elements/cells, are laminated the violations, connected with the cerebrospinal shock and with the reversible

changes in the traumatized nerve elements/cells, it is correct to evaluate the severity of damage/defeat extremely difficultly.

The generalization of the experience of the neuropathologists and neurosurgeons in World War II showed that for evaluating the severity of the damage of spinal cord and expected issue, besides the degree of functional violations, it is necessary to take into consideration following data: the severity of cerebrospinal shock, presence or absence of liquorrhea, change in the cerebro-spinal fluid, solid edema of the paralyzed extremities, speed of appearance and development of bedsores, cystitis and the character/nature of the latter. With the wounds of the cervical and upper- thoracic division of spine it is important to consider the pressure of the blood, frequency and character/nature of the pulse and of respiration, temperature of body, while with the wounds of the average/mean and lower division of spine - severity of vasomotor-trophic phenomena from the side of intestine and urinary system (blood in the calais, hematuria), the speed of the build-up of general/common/total depletion.

It is further extremely important to consider the character/nature of the wound of spine (penetrating or nonpenetrating), and with the penetrating wounds - is it tangent, through or blind.

With the perforating and blind-end penetrating wounds, besides the sizes/dimensions of the wounding shell, should be taken into consideration the path length, passed them along the spinal canal, and the ratio of the projection of this route/path to the center of the cross section of canal. It is very important to consider also the presence of pains in the paralyzed divisions of body, their intensity and periods of appearance after wound.

Although the being all-inclusive neurologic and qualified x-ray examination is attained in essence only in specialized establishments of army and front line area, the attempts to possibly more precisely explain the severity of the damage/defeat of spinal cord should be undertaken, also, in the preceding/previous stages of evacuation. Many of the enumerated signs whose account has high value for the recognition of the severity of damage/defeat, for example, liquorrhea, solid edema, hematuria, bedsores, cystitis, can be established/installed already in the institutions of military area. Therefore in the histories of disease/sickness/illness/malady it is extremely important to note, does take place liquorrhea or there are no, but in the presence its - it is not contained the blood or fatty droplets in the escaping cerebro-spinal fluid.

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If casualty in view of one or the other reasons is detained in the foremost stages of evacuation, in the histories of disease/sickness/illness/malady it is necessary to indicate the time of the appearance of hematuria, bedsores, cystitis and the character/nature of the latter.

In the absence or incompleteness of the recordings of neurologic violations in the histories of disease/sickness/illness/malady on the preceding/previous stages it is important on the basis of the inquiry of casualty to explain, was how direct or into the nearest hours after wound the condition of such basic functions as motor, sensitive and bladder, and, after taking into consideration the period, which passed from the moment/torque of wound, to compare them with the neurologic condition on the given day.

The analysis of a large number of histories of disease/sickness/illness/malady showed that the following special features/peculiarities of symptomatology and course of the bullet damage/defeat of spinal cord have great value from the point of view of the estimation of its severity, in particular, in the most critical sharp/acute and early period.



Light damage of spinal cord. After only several hours after wound appeared the first movements in the paralyzed extremities, sensitivity was not completely lost. The delay of urine was absent with it was rapidly changed by certain difficulty of urination. Tendinous-periosteal reflexes were preserved, but if they were lost, then they were reduced within the next few days; whereas pathological reflexes appeared from the first days or were absent. Trophic system was disrupted weakly or was not completely disrupted.

Occurred severe pains, especially during the damages of horse tail or during the sub-arachnoidal hemorrhages. Cerebro-spinal fluid was normal or slightly changed (elevated pressure, small increase in the quantity of protein or regular/prescribed elements/cells).

Wound related more frequently to the nonpenetrating ones, less frequent to the tangents and it is still less frequent to the blind-end penetrating wounds.

The damage of spinal cord usually weaker, the earlier began and the by the more rapid rates/tempos were reduced the initially lost functions. Frequently matter went about the jolt of spinal cord. Functional issue was favorable.

We give an example of the light damage/defeat of spinal cord.

Nonpenetrating wound of spine with the break of the awned extension of the XII thoracic vertebra, the contusion of spinal cord at this level and the sub-arachnoidal hemorrhage.

It is wounded by the bullet 23/IV 1943. At the moment of wound it was located in the strongly inclined position/situation. Immediately after wound paralysis of lower extremities and involuntary urination. The first light movements in the feet appeared after 16-18 hours, moreover simultaneously it began to experience in them sharp pain. Neurologic investigation (after 4 days): sharp pains in the lower extremities. Active movements in them are preserved in all large/coarse joints, but muscular force is sharply weakened. Patellar reflexes are absent, achilles hardly are caused. Decrease in the skin sensitivity from the level of pupart ligament. Urination and defecation are difficult. Cerebro-spinal fluid (puncture 29/IV) xanthochromium, ensues/escapes/flows out by frequent drops.

On the basis of established/installed data the neuropathologist placed the following diagnosis: the contusion of brain, sub-arachnoidal hemorrhage; prognosis favorable, laminectomy was not shown.

After 3 weeks: the light paresis of lower extremities, function of bladder and rectum they are normal.

Damage to average/mean severity. During the first hours and the days deep less frequently are full/total/complete paralysis, areflexion, gross violations of sensitivity, paralysis or paresis of bladder and rectum.

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Liquorrhea (especially with the wounds of lumbar division), but in the cerebro-spinal fluid, which escapes from the wound, and also in extracted via puncture there are no droplets of myeline, scraps of nerve tissue; there is an insignificant admixture/impurity of the blood. The delay of urine, especially with the high localization of wound, was rapidly changed by the alternate irretention with the imperative urges, etc.

The initially lost tendinous-periosteal reflexes began to be reduced through 1-2 weeks; simultaneously with them appeared one or the other pathological reflexes. Bedsores were absent or were expressed weakly. The wounds of spine were both the nonpenetrating and penetrating. With the blind-end penetrating wounds fine/small fragment comparatively shallow moved along the wound canal from the

place of entrance; but if wound was plotted/applied by more or less large/coarse fragments or bullet, then they were detained at the entrance into the spinal canal.

Functional prognosis, if wound was not complicated by the infection of cerebral shells or tissues of epidural space, on the whole favorable. A typical example of the wounds of average/mean severity is the following.

The quant. 11/III 1943 it is wounded by the fragment of artillery shell into the neck. To the short period it lost consciousness. After arriving into itself, it revealed/detected that it cannot move all four extremities. The first movements in the right extremities appeared after 12 hours. Urination was delayed. 15/III X-ray analysis. Metallic fragment is arranged/located in the awned extension of the III cervical vertebra; 15/III profound paresis of the right extremities and almost complete paralysis of the left. Gross disturbance of skin sensitivity on the right from the fourth neck segment and moderated - to the left, from the third segment: it is muscular - a joint feeling in the fingers/pins, the radiocarpal and talocrural joint is to the left lost, to the right - it is weakened. Urination independent, with the stress/voltage. Cerebro-spinal fluid without the substantial changes.

16/III laminectomy. On the posterior surface of small arc of the III neck vertebra is discovered the metallic fragment, which indented scrap of small arc into the spinal canal. Foreign body and scrap of

small arc are removed. Solid cerebral shell is not damaged. 12 days after wound active movements in the right extremities and in the left lower fully under the insignificantly weakened muscular force. Weakening skin sensitivity on the right half body from the fifth neck segment to the latter/last sacral, musculoarticular feeling in the left hand is disrupted roughly, in the fingers/pins of the left strut - it is insignificant. Urination is achieved normally. After wound the insignificant paresis of the proximal divisions of left hand and more expressed - hand and fingers/pins. Insignificant weakening of painful and temperature sensitivity on the right half body and the musculoarticular - in the fingers of left hand. Tendinous-periosteal reflexes to the left are somewhat higher. In other respects without the essential evasions from the norm.

In spite of paralysis of all four extremities immediately after wound, the appearance of the first active movements after 12 hours told about a comparatively moderate/mild damage of brain, that also was confirmed by further course. The timely elimination of the compression of spinal cord by scrap of small arc contributed to the rapid reverse development of functional violations.

Operation were the wounds of spinal cord by fine/small metallic  
removing spinal cord in the place of direct collision

described the remaining part  
of the operations due to

sectors of spinal cord proved to be weakly expressed, and wound at first glance produced the impression of moderate/mild.

P-v 12/IX 1941 obtained the multiple fragmentation wound of back. immediately after wound paralysis of lower extremities. The delay of the urine 15/IX 1941 it is delivered into the Leningrad neuro-surgical institute.

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The X-ray photographs: in the soft tissues of back several metal fragments of different sizes/dimensions; one fragment is arranged/located in the lumen of spinal canal to the right of center line at the level of small arc of the IX ore vertebra.

Neurologic: 16/IX full/total/complete paralysis of the right strut and deep paresis of left. The loss of painful and temperature sensitivity to the left from the eleventh thoracic segment, to the right - considerable weakening from the tenth thoracic segment. Tactile sensitivity is lost from both sides from the eleventh thoracic segment. Musculoarticular sensitivity is roughly disrupted in all joints of right leg and in the fingers/pins of left. Delay of urine.

The comparison of the inlet, formed by the fragment, which penetrated in the lumen of spinal canal, and its dispositions in the latter came to light/detected/exposed the following: inlet is arranged/located on 1.5-2 cm to the right of center line at the level of the awned extension of the VII thoracic vertebra. In the face X-ray photograph fragment penetrates to the right, almost in center line, at the level of this vertebra; in the profile X-ray photograph in the posterior division of the body of vertebra.

At first glance the damage/defeat of spinal cord produced the impression comparatively of the lung, since already to the third day there was a clinical picture of the partial violation of its conductivity. But the careful study of X-ray photographs, which showed that the fragment crossed the right half spinal canal close to the center line, it made it necessary to assume the heavy damage of the right half spinal cord. Further course confirmed the correctness of this assumption. 3 weeks after wound the paresis of the left strut and the violation of painful and temperature sensitivity on the rightist completely passed; paralysis of the right strut, disorder of the musculoarticular feeling in it, and also the gross violation of illness and temperature sensitivity on the left strut even through 1 1/2 month they remained without the changes.

Heavy damage of spinal cord. Full/total/complete paralysis, loss

of tendinous reflexes, paralysis of bladder and rectum. Casualty does not perceive or hardly perceives on the paralyzed extremities the energetic compression of the fold of skin, muscles, fingers/pins. The early appearance of bedsores, cystitis; the pressure of cerebro-spinal fluid more frequently lowered/reduced. In it the admixture/impurity of blood, later xanthochromia. More than in the half the cases was noted the partial or full/total/complete blockade of sub-arachnoidal space.

Wounds related to those penetrating, frequently to the blind or the through ones. If wound was plotted/applied by the large/coarse wounding shell, then the latter hardly penetrated in cavity of spinal canal; but if it was deposited by fine/small fragment, then the latter advanced in the spinal canal more or less deeply, besides close to the center of its cross section.

The further from the moment/torque of wound were held the described above neurologic phenomena, the more serious was estimated the severity of the damage of spinal cord. The described neurologic picture after 2-3 weeks after wound, especially if there are no indications of the compression of spinal cord, she spoke about the very poor functional prognosis.

If with the total loss of the conductivity of spinal cord was a



perforating or blind-end wound of spine and in the lumen of spinal canal was arranged/located large/coarse foreign body (bullet, large/coarse fragment), there was solid edema of the paralyzed extremities, and bedsores appeared after 3-4 days and irrepressible were developed, then most frequently matter went about the full/total/complete transverse contamination of brain.

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Topical diagnosis. Topical diagnosis must indicate the level of the disposition of focus and its extent in the horizontal and in the vertical direction. The experiment/experience of World War II showed that in the sharp/acute and early period the establishment of topical diagnosis ran into the great difficulties.

The smallest difficulties presented the recognition of the extent of focus in the horizontal direction. It was based on the data of the study of conductor and segmental functions. If were disrupted all conductor functions, then focus occupied entire diameter of spinal cord. During the violation only of the unit of these functions the focus occupied those divisions of the cross section of the spinal cord where pass the corresponding guides. On the localization of focus in these cases it is easy to judge by the accompanying schematic figure of the cross section of spinal cord (Fig. 49).

The extent of focus in the vertical direction established/installed on the basis the determinations of its upper and lower boundary.

Most important data for determining upper boundary of focus obtained by the experiment of skin sensitivity. The investigation by motor, reflector, vasomotor and other functions had smaller value, especially in the sharp/acute and early period. After determining level on the body surface from which begins the violation of sensitivity, and after being oriented by the scheme of the segmental innervation of skin (Fig. 50), it was easy to determine upper boundary of focus in the spinal cord: it will be by  $1-1\frac{1}{2}$  segment higher than that level from which begins the violation of sensitivity. On the basis of the affected segment, it was easy to determine the vertebra at the level of which was arranged/located the upper division of focus (Fig. 51).

However, this basic principle of topical diagnosis proved to be applicable only to the nonpenetrating wounds of spine, and from the penetrating wounds - only to the wounds of neck and upper-thoracic division. However, the application of it to the wounds of lower-thoracic and the upper unit of the lumbar division frequently

led to the errors. The most frequent error was the determination of localization of upper boundary of focus in the spinal cord considerably higher than real.

Sources of these errors following. As a result of the nonconformity of the length of spinal cord and spine low-thoracic and especially lumbar- sacral rootlets pass considerable distance along the spinal canal before they will move out it through the appropriate intervertebral apertures.

With the penetrating wounds of spine, especially through, combat shell or driven in by it into the lumen of wound canal bone scrap usually damaged not only spinal cord, but also rootlets which are passed by it at this level. Therefore with the wounds of lower-thoracic division of spine the disorders of sensitivity frequently had the dual pathogenesis: conductor, caused by the damage/defeat of the substance of spinal cord, and root, caused by the damage of rootlets at this level, but exiting from the higher segments of spinal cord.

Root disorders close over conductor ones. Overlap and, consequently, also the divergence/disagreement of the levels of the root and conductor disorders of sensitivity, as shows the given scheme (Fig. 51), they will be more considerable, is the more damaged

the lower division of brain. Thus, for instance, during the damage of the third neck segment upper boundaries of the conductor and root disorders of sensitivity will accurately indicate the localization of the upper level of focus in the spinal cord.

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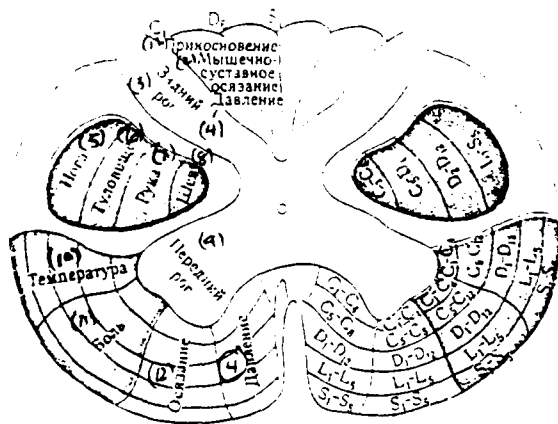


Fig. 49.

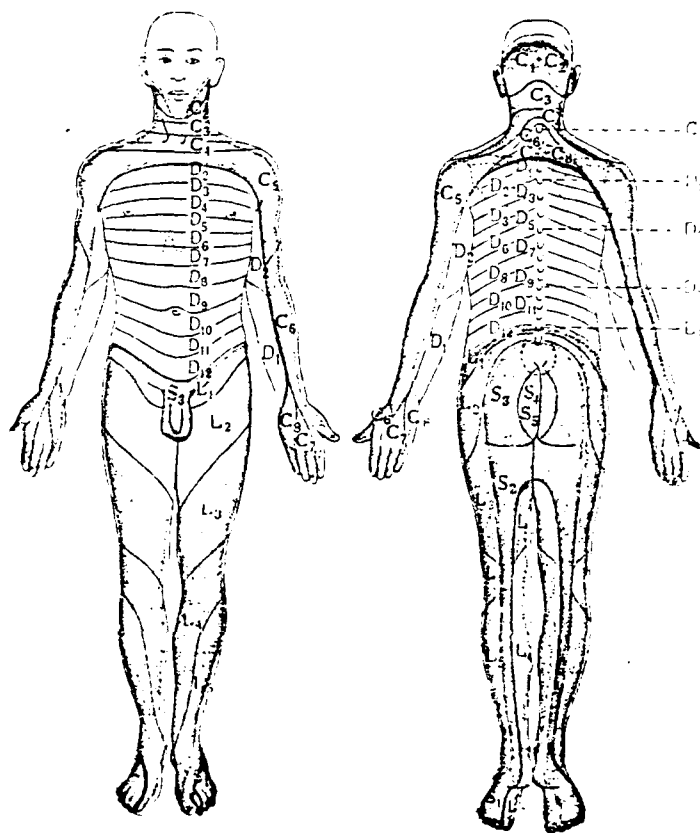


Fig. 50.

Fig. 49. Scheme of cross section of spinal cord.

Кей: (1). Touch. (2). Musculoarticular touch. (3). Posterior crescent. (4). Pressure. (5). Foot. (6). Body. (7). Hand. (8). Neck. (9). Front/leading crescent. (10). Temperature. (11). Pain. (12). Touch.

Fig. 50. Segmental innervation of skin.

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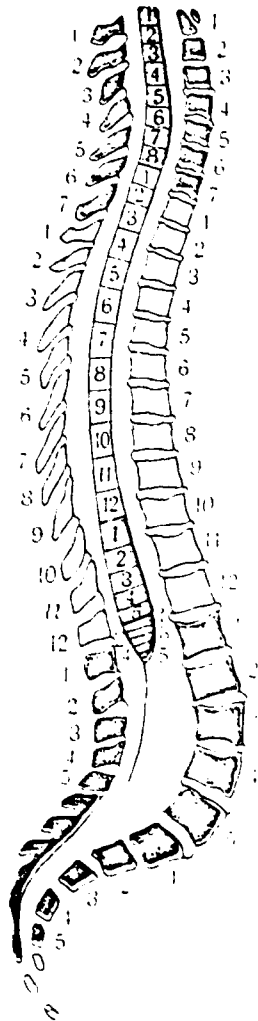


Fig. 51. Relationship/ratio of segments of spinal cord, bodies of vertebrae and awned extensions.

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However, during the damage of spinal cord and rootlets at the level of the XII thoracic vertebra the conductor violation of sensitivity will indicate the damage/defeat of the fourth lumbar segment, and root - to the damage/defeat of the twelfth thoracic segment. In this genus the cases the root disorders of sensitivity frequently assumed/took as the indication of localization of focus in the spinal cord and focus was determined considerably higher than it was arranged/located in actuality. These errors in turn, led a number of the authors, especially during the first 1-1 $\frac{1}{2}$  years of war, to the erroneous assertion, that localization of the damages of spine and stricken area in the spinal cord allegedly does not very frequently coincide.

By the second source of the errors in the determination of upper boundary of focus, according to the data of the study of sensitivity, was compression the epidural less frequently than subdural cut of rootlets by hematoma, and in the intermediate and late period - their implication in the inflammatory process and the scars with pachymeningitis and arachnoiditis. If both these of process applied to considerable elongation/extent upward from the focus in the spinal cord, then the caused by them root violation of sensitivity closed over the violation, caused by the damage of the substance of spinal

cord. As an example of the errors for this genus can serve the following observation.

R. obtained 13/IV 1942 the perforating bullet penetrating wound of spine at the level of the XI thoracic vertebra with the transverse contamination of brain at this level: chronic pachymeningitis.

Immediately after wound paralysis of lower extremities, delay of urine and feces, loss of sensitivity from the inguinal folds (from the words of casualty). Through 1 1/2 the weeks were connected the encircling pains. Neuropathologist, who inspected casualty after another week, after revealing/detecting the disorder of sensitivity from the tenth thoracic segment, localized stricken area in IX thoracic segment of spinal cord, i.e., (as showed autopsy) by 5 segments higher than real. Autopsy 2/V 1942. Break of the arched extension of the X thoracic vertebra and small arc of the XI thoracic vertebra (tangential penetrating wound). Solid cerebral shell is not damaged. Cross crushing of spinal cord at the level of the broken small arc (second lumbar segment). Fibrous-suppurative pachymeningitis for the elongation/extent from the VII thoracic to the III lumbar vertebra inclusively.

Two facts brought in neuropathologist's this case to the erroneous conclusion about the localization of the focus: 1) it did



not pay attention or did not attach value to the indication of casualty for the fact that within the next few days after wound the sensitivity was lost from the level of inguinal folds; 2) the root violations of sensitivity, caused by pachymeningitis, it accepted for the conductor ones.

The violation of sensitivity, not connected with the basic stricken area of brain, can be caused lying/horizontal above additional foci, more rarely ascending myelitis; in the later periods it could be caused by suprafocal reactive arachnoiditis, pachymeningitis, stagnation of spinal cord fluid/liquid. Therefore during the determination of upper boundary of the zone of maximum damage should be put to use the level of abrupt changes in the sensitivity.

Foci during the bullet damages/defeats of spinal cord greatly frequently have large extent in the vertical direction, covering 3-8, and sometimes also more than segments. Therefore the determination only of the upper boundary of focus cannot give idea about the real vertical sizes/dimensions of damage, plotted/applied to spinal cord by the wounding shell. Meanwhile in World War II many neuropathologists determined localization of focus exclusively only on its upper boundary. After determining, for example, the disorder of sensitivity from IX thoracic segment, neuropathologist consisted:

the bullet damage/defeat of spinal cord at the level of the eighth thoracic segment.

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A similar mechanical transference of rules/handspikes of the topical diagnosis of the diseases of spinal cord to the bullet damages/defeats of it is incorrect. The conclusions, made on the basis of them, led neuropathologist to the gross errors and confused surgeon.

As illustration can serve the following observation.

V-a obtained 17/II 1042 the blind-end bullet wound of back. Immediately after wound the loss of consciousness for 30-40 minutes and the development of paralysis of lower extremities. 23/II it entered into the evacuation hospital of front. The inlet of inter-blade region, on 3-4 cm to the left from the awned extension of the III thoracic vertebra. On X-ray - the break of the right half small arc of the VII thoracic vertebra (tangential penetrating wound). Bullet penetrated paravertebrally to the right of body of the IX thoracic vertebra.

24/II it is inspected by neuropathologist. "Lower paraplegia

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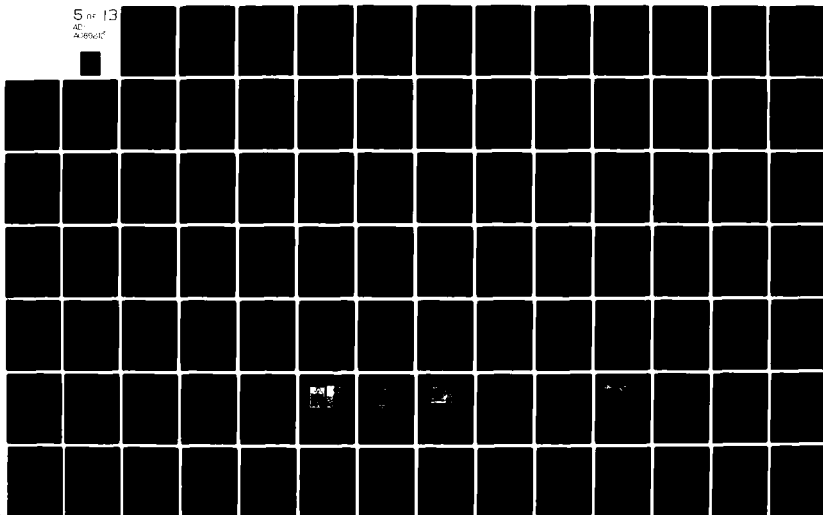
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with the loss of all abdominal and tendinous reflexes. Decrease in the sensitivity from the sixth and loss from the seventh thoracic segment. Delay of urine and feces. Conclusion: the bullet damage/defeat of spinal cord at the level of the sixth thoracic segment".

Casualty it perished after 2 weeks from suppurative meningitis.

Data of the autopsy: the break of small arcs the VII and VIII thoracic vertebra; in the epidural space several bone fragments. At the level of small arc of the VII thoracic vertebra longitudinal defect in the solid cerebral shell: the substance of spinal cord at the level of small arcs the VII and especially VIII and IX thoracic vertebra completely is crushed: upwards from the VII vertebra it for the elongation/extent 1-2 cm is edematic, it is thickened, it is pierced by the numerous foci of hemorrhage. Soft cerebral shells for entire elongation/extent are turbid and covered with suppurative coating.

In the given case the neuropathologist, relying on data of the study of sensitivity, counted himself right to localize the damage of spinal cord only in the sixth thoracic segment. However, autopsy showed that at the level indicated was arranged/located the continuation of focus; whereas basic focus (crushing of brain) was

localized in IX, tenth and eleventh thoracic segment.

In the sharp/acute and early period of the bullet trauma of spinal cord in the presence of cerebrospinal shock the determination of lower boundary of focus, which gives in the comparison with upper boundary representation about its extent in the vertical direction, is unrealizable.

As is known, the determination of lower boundary of focus is based on the data of the study of tendinous reflexes, shielding movements and muscular atrophies, and with typical hematomyelia -, also, on the investigation of skin sensitivity.

The tendinous reflexes whose reflector arcs pass through the stricken area, weaken or more frequently are lost, and those arranged/located are lower than the focus under the condition for its dissemination to the lateral columns - they are raised. Thus, an increase in this tendinous reflex tells about the fact that lower boundary of stricken area is arranged/located above its reflector center. But in the sharp/acute and early period tendinous reflexes during any heavy damages of spinal cord, as a result of the shock, disappear and therefore they cannot be used for determining lower boundary of focus. For this purpose it is possible to utilize them only after the disappearance of spinal shock.

Even smaller value had in this respect pathological stop reflexes (Babinski, Zhukovskiy, Rossolino, Oppengeym, etc.), since they appear with any localization of focus of higher than third-fourth lumbar segment.

Small value had an investigation of muscular atrophies; it could be used only for the localization of foci in the region of neck and lumbar- sacral thickening and also only in the later periods.

End Section.

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More vital importance had a study of shielding movements for the painful and cold stimulations, but also it was possible to utilize only after the transition of flaccid paresis or paralysis into the spastic, i.e., in the residual or intermediate period. After the reverse development of shock phenomena sometimes for determining lower boundary of focus with the use was applied the test/sample to perspiration (Yu. V. Il'in) and reflector dermographism (T. Yu. Yakubovskiy). In the divisions of body, innervated by the affected segments of spinal cord, perspiration and dermographism were absent or they were sharply weakened.

Thus, neuropathologist, relying on data of his method, had available in the sharp/acute and early period on the whole comparatively restricted possibilities for the establishment of a precise topical diagnosis. It could accurately recognize the extent of focus in the horizontal direction, establish/install the upper level of the dissemination of basic focus or supplementary foci, but always could not determine the vertical sizes/dimensions of focus, but within its limits - the sector of the maximum damage of spinal

cord.

Responses/answers to these questions neuropathologist had to search for, thoroughly analyzing the course of wound canal, X-ray photograph and further clinical course of wound.

The zone of the maximum damage of spinal cord was arranged/located, as a rule, at the level of the damaged vertebra or vertebrae. But from this zone pathological changes (reactive edema of brain, disorder of blood circulation, and in the later periods - arachnoiditis, epiduritis) with the decreasing intensity frequently were usually spread upward and downward to one or the other distance, sometimes considerable - to 2-3 and more than segments.

Considerably less frequent focus had smaller sizes/dimensions than the damage of spine. The latter, in particular, was observed during the damage of several cross or awned extensions. Thus, the author repeatedly observed the cases of the bullet breaks of several cross and awned extensions (during the deposition of wound by the wounding shell, which were moving in parallel to the axis of spine), where the focus in the spinal cord was localized at the level only of any vertebra.

A-v is wounded 21 May 1944 by bullet during the rush. It ran,



having been strongly bent down to the earth/ground. Immediately after wound paralysis of lower extremities, delay of urine and chair/stool. Data of neurologic study from 27 May: a deep paresis of lower extremities with flaccid patellar and achilles reflexes when the symptoms of Babinski and Rossolimo are present. Sharp weakening of skin sensitivity from the tenth thoracic segment. Urination independent, but with the large stress/voltage. data of surgical study: inlet along the center line in the region of the awned extension of the X thoracic vertebra. Of X-ray photographs: the break of the awned extensions VI, VII, VIII and IX thoracic vertebra. 27 July light spastic paraparesis. Urination and defecation are normal. The upper and average/mean average/mean abdominal reflexes living, lower are not caused. Decrease in the skin sensitivity from the twelfth thoracic segment.

In the given case the focus of damage was arranged/located only at the level of the IX thoracic vertebra, although were damaged the VI, VII, VIII and IX thoracic vertebra.

Only sometimes was observed the rough noncoincidence of the place of the damage of spine and localization of the maximum zone of damage in the spinal cord.

As an example can serve the following observation.

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S-ov obtained on 4 September 1942 the perforating nonpenetrating bullet wound of spine with the break of the awned extension of the VII thoracic vertebra and the syndrome of the partial violation of the conductivity of spinal cord.

Inlet to the right, in the angle of spatula, exit - approximately/exemplarily at the same level to the left, somewhat towards the outside of the angle of spatula. X-ray pictures: the break of awned extension and, possibly, small arc of the VII thoracic vertebra.

Immediately after wound paralysis of lower extremities, delay of urine and feces. 5 September light bending movements in the coxofemoral joints, loss of tendinous reflexes on the lower extremities, sufficiently sharply pronounced weakening of skin sensitivity from the eighth thoracic along the second lumbar segment and loss from the third lumbar to the fifth sacral segment inclusively. Paralysis of bladder and rectum. Pressure of cerebro-spinal fluid is increased. Cerebro-spinal fluid several xanthochromium, slightly opalesces. Cytosis of 34 in 1 mm<sup>3</sup> on 25

September (21 days after wound) distinct paresis of the flexors of thighs, deep paresis of the extensors of shin, paralysis of foot and fingers/pins. Patellar reflexes hardly are caused, achilles reflexes are lost. Light weakening of skin sensitivity with IX thoracic on the third lumbar segment, gross weakening in the region of the fourth and fifth lumbar segment and total loss in all sacral ones. In 2 months from the moment/torque of the wound: atrophic paralysis is of the foot with the loss of achilles reflexes, moderate paresis of shins. Hardly the noticeable weakening of skin sensitivity from the tenth thoracic on the fifth lumbar segment inclusively and almost total loss in the sacral segments. Paralysis of the bladder.

Clinical diagnosis: the perforating nonpenetrating bullet wound of spine at the level of the VII thoracic vertebra. Contusion of spinal cord at the level of the damaged vertebra: the focus of hemorrhage in the epicone and cone of spinal cord.

In the given case in the division of spinal cord, which corresponds to the damaged vertebra, was an insignificant focus; whereas basic focus arose in the cone and partially it captured in the sharp/acute period of the epicone.

Within the later periods when shock phenomena underwent reverse development and began to be drawn stable changes, precise data about

the localization and the sizes/dimensions of focus gave precisely executed neurologic study.

In the presence of the blockade of sub-arachnoidal space for determining its lower boundary frequently was applied the introduction of the air through the lumbar puncture. X-ray analysis by the contrast substances (lipicdol) for determining upper and lower boundary was applied rarely.

In the cases of the blind-end and perforating wounds of spinal canal important data for the judgment about the vertical sizes/dimensions of focus provided the path length, passed along the canal by the wounding shell. The longer this route/path, the greater there were the vertical sizes/dimensions of focus. An example of this genus of wounds is given above.

Prognosis of the bullet wounds of spine. The experiment/experience of the Great Patriotic War showed that not only the functional, but also vital prognosis with the bullet wounds of spine should be placed very carefully. Although the general/common/total percentage of the fatal results was considerably below (45.6), than in the first world war (80, 0, N. N. Burdenko), nevertheless it remained high.

If had good reason to assume the full/total/complete transverse contamination of spinal cord, prognosis must be especially serious. The overwhelming majority of casualties with the full/total/complete transverse contamination of spinal cord perished during the next weeks after wound; a few remained in living in the course of several months, unit - during several years, and that with the particularly careful departure/attendance.

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During the establishment of vital prognosis it is necessary to take into consideration not only the severity of the damage of spinal cord, but also its localization. The greatest direct danger for the life present the damages/defeats of upper-neck division of spinal cord. Because of the nearness of the medulla oblongata and localization in the fourth neck segment of the nuclei/kernels of the thoracoperitoneal nerve, the casualties, who survived the first 2-3 hours after wound, subsequently perished from paralysis of respiration or from the sharp disorder of blood circulation. Sharp/acute period survived only those of them, whose damage of spinal cord was comparative the lung.

Since casualties with any considerable damages/defeats of neck division, especially upper segments, perished soon, then in the

survived the first 2-3 weeks not only vital, but also functional prognosis was more frequently good. 3 Weeks after wound the fatal results during the damages/defeats of neck division were observed comparatively rarely.

Are vitally risky also the damages/defeats of lower neck and first three upper thoracic segments. To weakening of the respiratory/breathing function, caused by paralysis of interfin musculature, here was connected the sharp/acute violation of heart activity.

The damages of the remaining divisions of spinal cord present the smaller direct threat of the life of casualty. Therefore of the number of those affected into this division the sharp/acute period survived the relatively larger percentage of casualties, than during the damages/defeats of neck or upper-thoracic division. But they in the considerably larger percentage perished subsequently, from the various kinds of complications (pneumonia, sepsis, depletion).

Liquorrhea, indisputable symptom of the violation of the integrity of solid cerebral shell, also very darken vital prognosis. The suppressing number of casualties with liquorrhea, especially prolonged and not in proper time removed operationally, perished. Liquorrhea it was it was observed with the large/coarse defects in

the solid cerebral shell, and the latter, almost as a rule, they were combined with the rough damages/defeats of spinal cord, frequently with its full/total/complete transverse contamination. However, only a little larger than in the half the cases of liquorrhea, lethal outcome was caused by the severity of the damage/defeat of spinal cord, in the remaining cases the reason for lethal outcome were suppurative complications from the side of shells and substance of spinal cord. This occurred mainly in such cases of wounds with which according to one or the other reasons it could not be applied energetic treatment by sulfanilamides and antibiotics.

Vital prognosis darkens also presence in cerebro-spinal fluid of a considerable quantity of blood, droplets of myeline and tearing of cerebral tissue.

By equal mode the rapid and irrepressible progressive development of bedsores and hemorrhagic cystitis must impel to the extremely conservative estimate of vital prognosis.

The extremely important fact, which darkens vital prognosis, was the simultaneous wound of the organs/controls of thoracic or peritoneal area. Thus, based on materials of the development of the histories of disease/sickness/illness/malady, in 70.40/o of individuals who died there was the combined wound of spine and only

in 29.60/o - isolated/insulated.

Approximately/exemplarily in the half the cases of the combined wounds lethal outcome was caused not by the damage of spinal cord, in a series/number of the cases carried a comparatively light character/nature, but by the wound of internal organ/control.

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However, in these cases the damage of spinal cord nevertheless contributed to lethal outcome. The called by it damage of function and trophic system both affected and other organs/controls complicated the severity of the general condition of casualty. For example, hemothorax in the combination with the damage/defeat of upper-thoracic division of spinal cord led to the lethal outcome with such degrees of development, with which the isolated/insulated damage/defeat of this division is usually finished happily. The difficulty of the respiratory/breathing function of the lung, caused by hemothorax, was complicated by the paresis of interfin muscles, and possibly, and by dystrophic changes of the pulmonary parenchyma in the divisions of the lung, innervated by the affected segments of spinal cord.

Among the combined wounds of spinal cord and internal



organs/controls by one and the same wounding shell from the point of view of vital prognosis special position they occupy the wound of intestine, in particular, thick. The danger of the heavy infection of spinal cord and its shells in these cases is extremely great. However, position/situation according to Krause, that these cases are hopeless and no surgical intervention on the spinal cord can save casualty, it is disproved by observations in the Great Patriotic War. Timely intervention on the intestine and energetic use/application of antibiotics in the majority of the cases prevented the development of infection in the spinal cord and its shells and they provided subsequently if necessary the possibility of surgical intervention on the spinal cord.

The extensive wounds of soft tissues, in particular infected with the most virulent forms of microbes, also created the considerable threat of the life or casualty even during a comparatively insignificant damage of spinal cord. The highest percentage of lethal outcomes was observed during the association of the series/number of the pathogenic microbes.

Prognosis darkened extensive interabdominal hematomas, in particular if they were caused by the same combat shell which inflicted damage/defeat to spinal cord. Interabdominal hematomas frequently rotted. Infection along the wound canal, which is

connected with the area of spinal canal, or through intervertebral aperture sometimes penetrated the epidural and further into the sub-arachnoidal space, and also into the substance of spinal cord, causing the severe suppurative complications (suppurative pachymeningitis, leptomeningitis, meningomyelitis).

Within the later periods vital prognosis darkened by osteomyelitis of the vertebrae on soil of which sometimes appeared lethal suppurative complications in the shells and the substance of spinal cord. Were especially risky osteomyelitis of rump. The majority of them ended with a fatal result in connection with the depletion or with their developing on soil suppurative meningitis.

Roentgenological diagnosis of the bullet wounds of spine and spinal cord.

The first attempts at the use/application of a roentgenological method of study for the diagnosis of the bullet wounds of spine and spinal cord were undertaken by the Russian authors during the first world war (A. L. Polenov, O. S. Bokastova, S. R. Mirotvortsev and A. B. Panskiy). The Soviet authors continued to work in this direction and during the war with the White Finns.

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However, these works not of the distance of essential results, first of all, because they were not based on the sharp anatomical analysis of the roentgenological image of spine, furthermore, the number of made observations was insufficient.

At the beginning of the Great Patriotic War the anatomical interpretation of the X-ray photographs of spine proved to be in the proper measure of that developed because of the works of the series/number of the Soviet researchers (D. G. Rokhlin, V. S. Maykova-Stroganov, A. Ye. Rudasneva, V. I. Bik, I. I. Shakov et al.). Because of this was removed the basic obstruction, which inhibited the development of the roentgenological diagnosis of the bullet wounds of spine and spinal cord. Being based on the correct X-ray anatomical analysis of spine, Soviet roentgenologists during the Great Patriotic War developed this chapter of military roentgenology with the sufficient completeness (N. S. Kosinskaya, V. S. Maykova-Stroganov et al.). Judging according to published data, foreign authors did not pay proper attention to the X-ray diagnostics of these heavy wounds.

The Soviet authors considered it necessary to, first of all, establish/install roentgenological reference points for the tentative judgment about degree and character/nature of the damage of spinal cord, since in the majority of the cases these questions cannot be in proper time solved via the analysis of some clinical data.

The roentgenological method of study with the bullet wounds of spine had high value especially in the early period, because on the basis of clinical data at this time it was not always the possible to in proper time establish/install the picture of the damage of spinal cord. Very frequently the character/nature of wound could be identified only via X-ray anatomical analysis of wound, compared with clinical data.

The character/nature of the damage of spine and spinal cord was distinguished during the primary x-ray examination, which was conducted in the first twenty-four hours after the admission of casualty into the institution where had to be realized in the presence of readings radical treatment. Therefore the primary x-ray examination of those wounded into the spine during the Great Patriotic War most frequently was conducted in the specialized separations/sections of the hospitals of army or front line area.

Early, at least tentative, diagnosis of degree and

character/nature of the damage of spinal cord are necessary for the realization of correct classification and differentiated treatment of these casualties. The problem indicated to the known degree was solved on the basis of clinico-roentgenoanatomical classification of bullet wounds and damages of spine and spinal cord.

Because of this classification during the primary x-ray examination of casualties it was the possible to secrete different types of the damage of spine. Each of these types differed according to degree and character/nature of the damage of spine and spinal cord and could be established/installed on the basis of the roentgenological symptomatology, compared with clinical data.

The spinal cord, closed in the narrow bone cover and which includes a large quantity of conducting paths and centers on the very insignificant diameter, even with the small wounds can give the disseminated clinical symptomatology.

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Because of this roentgenologist's basic problem with the bullet wounds of spine and spinal cord consisted in the establishment of the relationships/ratios between the wound canal and the spinal canal. Findings contributed to the early recognition of the character/nature

of the damages of spine and spinal cord. Based on this principle, all bullet wounds of spine and spinal cord were divided into five different types (Fig. 52). With I type wounds wound canal crosses/intersects spinal canal (Fig. 52, I). With II type wounds wound canal it is finished in the spinal canal (Fig. 52, II). With III type wounds wound canal it passes through the bone walls of spinal canal, destroying them, but it does not penetrate depthward it (Fig. 52, III).

With IV type wounds wound canal is passed out of the spinal canal. In this case are damaged only such divisions of spine, which do not accept participation in the formation of the internal walls of spinal canal (Fig. 52, IV). With V type wounds wound canal is passed out of the spine, and spinal cord directly is not damaged (Fig. 52, V).

As a result of the insignificance of the diameters of spinal canal and spinal cord with I type wounds, almost as a rule, occurred the anatomical interruption of spinal cord, since shell, crossing/intersecting spinal canal, destroyed included in it spinal cord. With I type wounds clinically most frequently was detected the full/total/complete violation of the conductivity of spinal cord. However, this syndrome frequently was observed also with the wounds of all remaining types; the difference in the neurologic symptoms

sometimes appeared only later more or less considerable time after wound.

With II type wounds the degree of damage in the majority of the cases depended on the value of the foreign body, which was incorporated in the spinal canal. With the wounds of this type spinal cord it could be: 1) it is completely destroyed, 2) it is partially damaged or 3) it is only contused and constrained by foreign body.

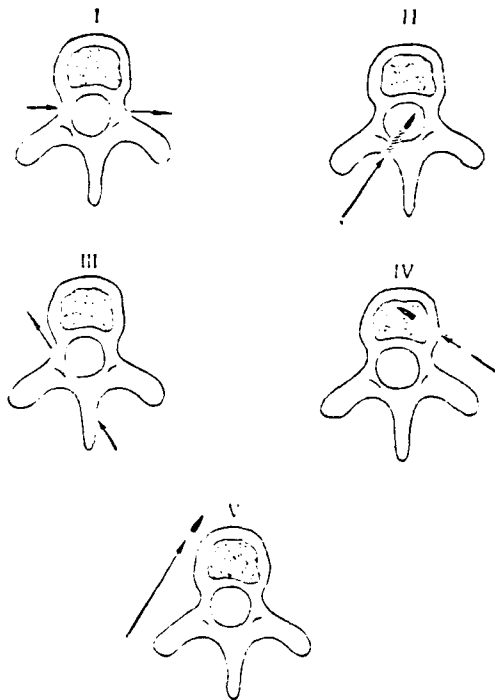


Fig. 52. Diagrammatic representation of different types of the bullet wounds of spine and spinal cord which are determined by the interrelations between the wound canal and the spinal canal.

I type - wound canal crosses/intersects spinal canal; the II type - wound canal is finished in the spinal canal; the III type - wound canal disturbs the integrity of the walls of spinal canal, but it does not penetrate depthward it; the IV type - wound canal passes out of the spinal canal; the V type - wound canal passes out of the



spine, directly without damaging it.

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With III type wounds the anatomical integrity of spinal cord in the overwhelming majority of the cases macroscopically was not disturbed, but solid cerebral shell could be damaged. Neurologic picture in these cases, as a rule, depended on contusion and compression of spinal cord, and subsequently - limber from the series/number secondary changes in the substance of spinal cord and its shells.

With IV type wounds neither spinal cord its nor shells directly were drawn into the zone of wound canal. Neurologic changes in this case could completeness be absent or there were more or less expressed symptoms of the damage of spinal cord, up to the full/total/complete viciation of conductivities which were caused by the contusion of spinal cord as a result of the transmission shock of different degree.

With V type wounds neither spine nor spinal cord were the place of the direct application of the manpower of the wounding shell. With these wounds just as with IV type wounds, spinal cord was not damaged roughly mechanically and was not squeezed, but it suffered as a

result of the complex traumatic ones, but subsequently the degenerate ones and Rubtsovs changes. The functional disorders, which appeared with IV and V type wounds, could be decreased in the course of time or, on the contrary, grow on, leading in certain cases to the full/total/complete viciation of the conductivity of spinal cord.

Type of the damage was established on the basis of the anatomical analysis of two X-ray photographs of spine, produced in the mutually perpendicular projections, and the comparison of roentgenological data with clinical. For this purpose it was required no additional roentgenological methods of study (laminography, stereo-X-ray analysis, myelography, etc.), in consequence of which the procedure of study was simple and accessible. For refining the diagnosis in certain cases proved to be necessary only supplementary fluoroscopy for the establishment of localization of the foreign body, which dwelled on considerable distance from the region of the wound of spine. This investigation was conducted simultaneously with the fluoroscopy of chest and abdominal area. The latter was conducted all by that wounded the region of spine during primary roentgenological study in order to come to light/detect/expose the condition of internal organs/controls.

Each type of the bullet wound of spine and spinal cord has characteristic for it roentgenological symptomatology.

I type of the bullet wounds of spine and spinal cord. With the wounds of spine and I type spinal cord wound canal, almost as a rule, it passed to frontal plane. In this case were destroyed scalene side walls of spinal canal, which were represented mainly by the roots of the small arc of vertebra. Such wounds in the majority of the cases were deposited by the bullets, which possessed considerable progressive/forward force. Wound canal was frequently very narrow, that caused the isolated/insulated breaking up only of the roots of the small arc of vertebra. In this case the adjacent divisions of spinal column, in particular, very small arcs of vertebrae, suffered insignificantly or even in no way they were damaged (Fig. 53).

Because of this the straight/direct roentgenological symptom of the wounds of spine and I type spinal cord was the decomposition of the scalene roots of of arch one or several vertebrae. In this case in the X-ray photographs of spine in the posterior projection in the appropriate sectors was detected the gap of the outlines of the image of the root of the small arc of vertebra (Fig. 54). This image under normal conditions always takes the form of the correct closed oval.

If wound canal is passed horizontally, were destroyed two roots of the small arc of one vertebra (Fig. 53). With the oblique course of wound canal - on the one hand to another and at the same time from bottom to top, thinner/less frequent - on the contrary, appeared the break of two or several scalene roots of the small arcs of different vertebrae, which are located on the different levels (Fig. 54).

The symptom indicated is so characteristic for the data of wounds that in the presence its the appropriate diagnosis could be placed on the bases of the analysis only of the one posterior X-ray photograph of spine (Fig. 54). In the lateral X-ray photographs of spine in such cases usually was detected the intense blanket of spinal canal at the level of wound (Fig. 53). This blanket was caused by the displacement of bone fragments into the spinal canal and by hemorrhage in it.

The somewhat more rarely wounding shell, which passed to the frontal plane through the spinal canal, destroyed all walls of the latter. In this case occurred the full/total/complete breaking up of all component elements of arch of one (Fig. 55) or several adjacent vertebrae. Sometimes simultaneously was damaged the posterior body surface of the corresponding vertebra. In all similar casualties invariably/unchangedly was detected the decomposition of the many-sided roots of small arc of one (Fig. 55) or several vertebrae. In such cases frequently appeared the sharp displacement of bone fragments.

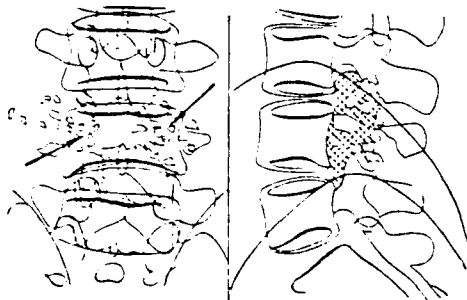


Fig. 53.

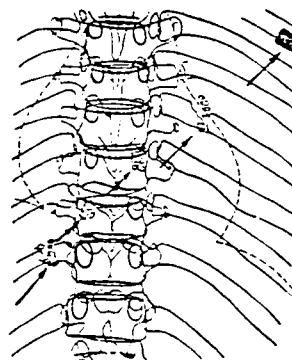


Fig. 54.

Fig. 53. Anatomical schemes from X-ray photographs of lumbar division of spine of casualty H. Perforating bullet wound of lumbar region in the horizontal plane. In the posterior X-ray photograph is determined breaking up of both roots of small arc of the IV lumbar vertebra (it is shown by arrows/pointers), the upper joint extensions of the III lumbar vertebra with complete destruction of both joints. Break of the right lower joint extension of the IV lumbar vertebra, adjacent sector of the posterior division or the arc of this vertebra and both cross extensions. All bone scrap are disorderly displaced in different directions. In the lateral X-ray photograph is detected the blanket of spinal canal at this level (shaded division of spinal canal is shaded into the cell). The wound of spine of the I type, casualty canal passed horizontally in the frontal plane through the

spinal canal at the level of the IV lumbar vertebra.

Fig. 54. Anatomical scheme from posterior X-ray photograph of lower-thoracic division of wounded P. <sup>Elung</sup> ~~Slepov~~'s spine bullet wound of chest. In the posterior X-ray photograph of spine is outlined entire course of wound canal. On the course of wound canal occurred the breaking up of the paravertebral sector of right XI edge/fin, right root of small arc of the X thoracic vertebra, left root of small arc of IX thoracic and paravertebral sector of left VIII edge/fin.

Bullet was stopped in the left half chest. The breaking up of the scalene roots of the small arc or vertebrae indicates the wound of spine and I type spinal cord. The decomposition of the roots of the small arc of two different vertebrae testifies about the bias of the course of the wound canal (entire course of wound canal is shown by arrows/pointers, moreover the crushed roots of small arc of the IX and X thoracic vertebra are noted by double arrows).

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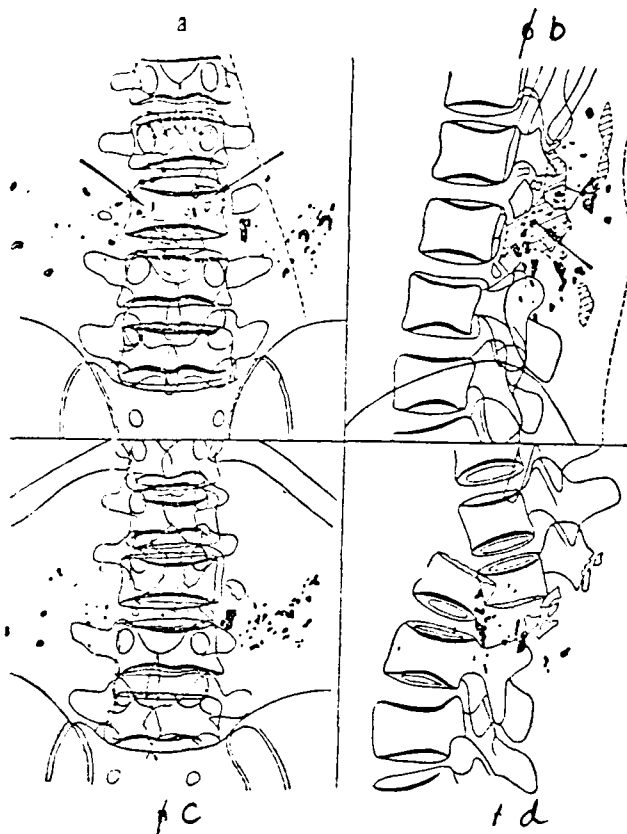


Fig. 55. Anatomical schemes from series of X-ray photographs of lumbar division of spine of casualty B. Perforating bullet wound of lumbar region. During the primary x-ray examination (a, b) is discovered the wound of I type of vertebra. In the posterior X-ray photograph (a) is determined absence of both roots of small arc of the III lumbar vertebra (it is shown by arrows/pointers) and breaking up of all remaining sectors of the small arc of this vertebra with

the complete destruction of the walls of spinal canal. Breaking up of both of lower joint extensions and posterior division of the small arc of this vertebra together with the the spinous process. All bone fragments are disorderly considerably displaced. On lateral X-ray picture (b) is detected the image of the gaping wound canal, filled with air (it is shaded and it is noted with arrow/pointer).

Throughout entire wound canal are scattered multiple fine/small foreign bodies. During the repeated experiment in 2 months (c, d) is determined osteomyelitis of bodies of the II and III lumbar vertebra. The destruction of adjacent closing plates of the bodies of the vertebrae indicated. As a result of the decomposition of the entire small arc of the III lumbar vertebra and entire ligamentous/connecting apparatus the described destruction led to the full/total/complete separation of spinal column at this level to two independent divisions. In this case the caudal division of spine was displaced toward the front and it visited the cranial to the height of one vertebra. Because of this the image of bodies of the II and III lumbar vertebra in the posterior X-ray photograph mutually they are laminated.

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Because of this in the X-ray photographs instead of common for these wounds break of the outlines of the image of the root of the small



arc of vertebra (Fig. 54), which reminds in the norm letter O, sometimes was determined the full/total/complete absence of this sector of small arc (Fig. 55).

Only in the casuistic cases the described wound could not be identified on the basis of the analysis of the posterior X-ray photograph of spine, namely when the bullet, which possessed considerable progressive/forward force and which formed narrow wound canal, passed to the horizontal plane through two intervertebral apertures. In this case was destroyed only the posterior-lower sector of the body of the corresponding vertebra whose fragments were displaced into the spinal canal. This wound was not detected in the posterior X-ray photograph of spine and was revealed/detected only in its lateral photograph (Fig. 56).

The described roentgenological symptoms were observed in the overwhelming majority of the wounds of spine and I type spinal cord and they were caused by the course of wound canal in the frontal plane. With I type wounds the passage of shell in the sagittal plane almost never was encountered, since in the heading of shell in the sagittal plane from the front or problems usually appeared the incompatible with the life damages of the internal organs/controls of adjacent areas. But if this it did not occur, foreign body was introduced in the body of vertebra and in the majority of the cases

was detained in it. With the course of wound canal in the sagittal plane from behind in advance the shell frequently remained among the fragments of the posterior division of the small arc of vertebra or penetrated the spinal canal and was detained in it.

Only the very rarely wounding shell, after destroying the posterior division of the small arc of vertebra and after entering into the spinal canal, crossed/intersected the latter and was introduced in the body of vertebra (Fig. 58) or intervertebral disk (Fig. 57). In this case appeared the perforating wound of spinal canal with the blind-end wound of spinal column, i.e., I type of the wounds of spine and spinal cord.

Roentgenologically in such cases was detected the breaking up of the posterior division of the small arc of vertebra (Fig. 57 and 58), foreign body in the body of vertebra (Fig. 58) or in the disk (Fig. 57) and the blanket of spinal canal at the level of damage. The roots of the small arc of vertebra in this case usually were not damaged. The sector of the breaking up of the posterior division of small arc had different value. Sometimes its sizes/dimensions were very insignificant (Fig. 57).

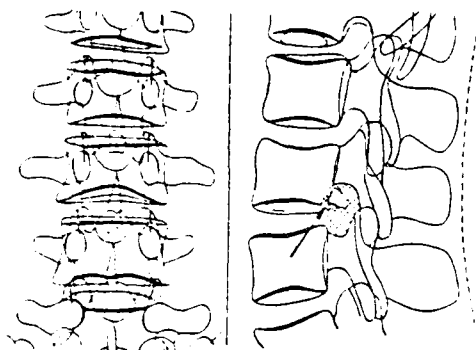


Fig. 56. Anatomical schemes from the X-ray photographs of the lumbar division of spine wounded B. Perforating bullet wound of lumbar region in the frontal plane. In the posterior X-ray photograph pathological changes in the spine are not determined. In the lateral X-ray photograph is detected the breaking up of the rear lower sector of body of the III lumbar vertebra (it is shown by arrow/pointer). Bone fragments were displaced into the vertebral canal. The latter at this level is shaded (it is shaded into the cell). The wounded canal crossed the spinal canal through two intervertebral apertures. Wound of I type spine.

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Such wounds were almost equally frequently deposited by bullets, and by the metallic fragments of different origin. Extremely rarely this damage could be caused by the fine/small fragment of shell,

which possesses considerable progressive/forward force. In these very rare cases, in spite of the I type of wound, sometimes occurred not the full/total/complete anatomical interruption of spinal cord, but its only partial wound.

Consequently, in sagittal guiding of wound canal with the given wounds was always damaged the body of vertebra or intervertebral disk. In this case in the X-ray photographs invariably/unchangedly was detected the absence or the compression of the body of the damaged vertebra (Fig. 58) and the normal height of the intervertebral disk (Fig. 57). This characteristic feature was revealed/detected with all bullet wounds of the bodies of vertebrae and intervertebral disks and it sharply differed them from the damages, which appear with the closed trauma. Appearance after the bullet wound of the cuneate deformation of the body of vertebra (Fig. 58) or reduction in the height of disk (Fig. 57) always testified about the relative remoteness of wound and indicated the presence of active either chronic osteomyelitis or degenerate changes in the disk.

II type of the bullet wounds of spine and spinal cord. The straight/direct roentgenological symptom of the wounds of spine and II type spinal cord was the presence of foreign body in the spinal canal (Fig. 59 and 60).

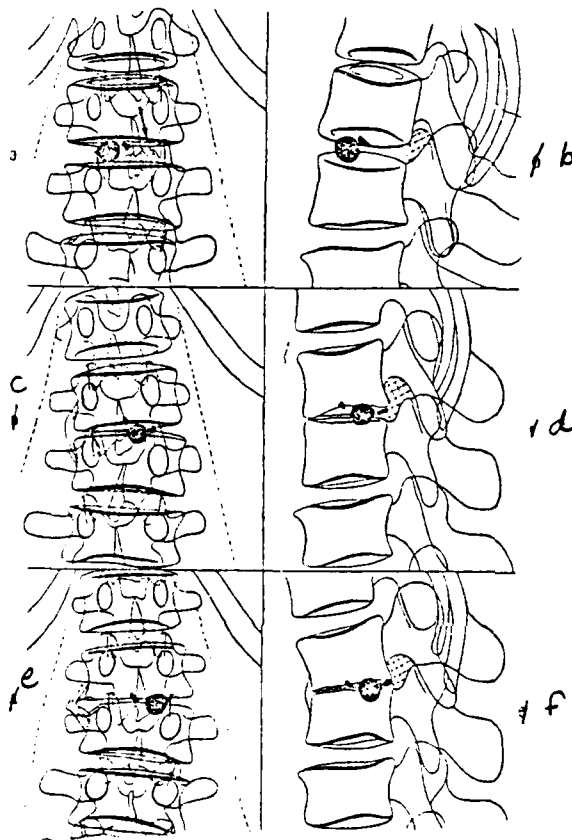


Fig. 57. Anatomical schemes from the series of the X-ray photographs of the lumbar division of spine of wounded G. Blind-end wound into the loin by shrapnel bullet. During the primary x-ray examination (a, b) is discovered the breaking up of the left lower joint extension of II lumbar vertebra (it is shown by arrow/pointer), bullet and several fine/small metallic foreign bodies in the front/leading division of the right half of intervertebral disk, located between the II and III lumbar vertebra. Spinal canal at this level is shaded. Bullet crossed

spinal canal in the sagittal plane from behind in advance and it was incorporated in the disk, after causing the wound of I type spine. The height of the intervertebral disk is not lowered, in spite of its explicit wound. During the repeated x-ray examination in a month (c, d). Considerable reduction in the height of the intervertebral disk, destruction of adjacent closing plates of bodies of the II and III lumbar vertebra and the calcification of the crushed towards the outside right half front/leading longitudinal ligament at this level (c). Shrapnel bullet moved to the left (c) and toward the rear (d) and it is located in posterior-internal sector of the left half disk. Even more greatly overturned one of the fine/small foreign bodies. These symptoms testified about the presence of osteomyelitis of bodies of the II and III vertebra. During the following x-ray examination (e, f), 3 weeks of the afterward second, is established/installed the build-up/growth of the destruction of bodies of the II and III lumbar vertebra and the almost complete destruction of the corresponding disk. Considerably increased the calcification of front/leading longitudinal ligament. Shrapnel bullet was stuck into body of the II vertebra as a result of its osteolysis. Appeared kyphosis at this level (f).

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The wounding shell was most frequently headed in the sagittal

plane from behind in advance. Wound canal in such cases was short, it frequently passed horizontally, crushing only the insignificant sector of the posterior wall of spinal canal (Fig. 59). The roots of the small arc of vertebra in these cases usually were not damaged.

With the horizontal course of wound canal the localization of wound on the skin coincided with the level of the sector of the damage of spine and the location of foreign body in the spinal canal.

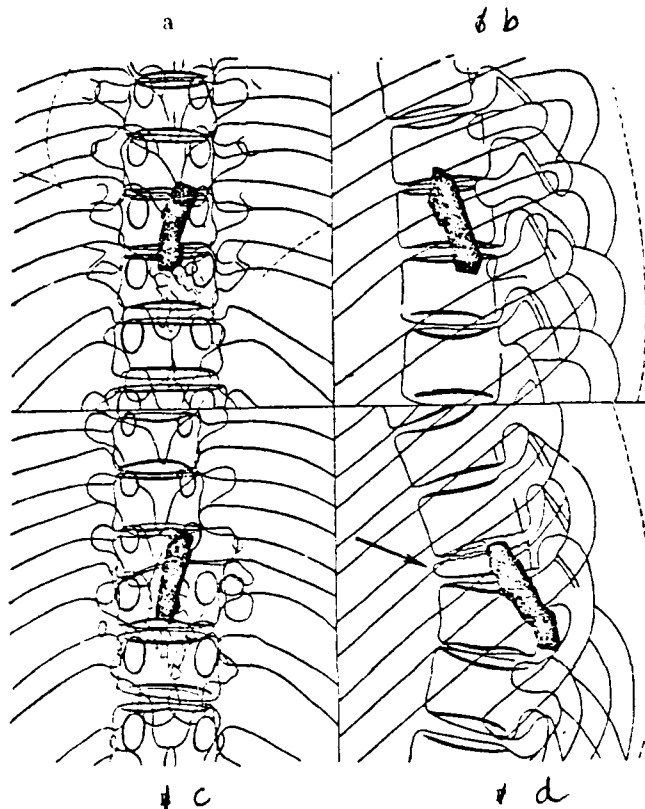


Fig. 58. Anatomical schemes from the series of the X-ray photographs of the lower-thoracic division of spine wounded T. Blind-end fragmentation wound of spine along the center line. During the primary x-ray examination (a, b) is established/installed the breaking up of the posterior division of arc of the X thoracic vertebra together with the the spine fragment and the foreign body, which was wedged in vertically into the middle of body of the IX vertebra, into both adjacent disks and corresponding sectors of body of the VIII and X thoracic vertebra. Given data, compared with the



clinical ones, testified about the wound of I type spine, since the wounding shell passed slantwise in the sagittal plane from behind from below toward the front and upwards, crossed spinal canal and was incorporated in bodies and disks of three adjacent vertebrae. The height of the bodies of vertebrae and intervertebral disks is not lowered. In 2 months, during the repeated x-ray examination (c, d), is discovered osteomyelitis of bodies of the VIII and IX thoracic vertebra with the extensive destruction and the sharp compression of body of the IX thoracic vertebra (it is shown by arrow/pointer in Fig. d). Simultaneously occurred the insignificant displacement of the caudal division of spine to the left (c). The height of the corresponding disks is sharply lowered. Was formed kyphosis (d). As a result of the compression of body of the IX thoracic vertebra and sharp reduction in the height of disks occurred the transfer of the foreign body whose lower end was incorporated in the spinal canal and crossed it at the level of X thoracic vertebra.

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With such wounds of the lumbar division of spine the foreign body rarely penetrated the spinal canal through the interspinal and yellow ligament, without having destroyed the integrity of bones. This is possible as a result of the horizontal position of the awned extensions of lumbar vertebrae. The same wound sometimes appeared in

- a lumbar-sacral division of spine in the presence spina bifida. In
- the neck and thoracic division of spine the wounding shell could not penetrate in the spinal canal, without having injured bone, since the awned extensions of these vertebrae are imbricated to each other and is formed continuous bone wall.

Somewhat thinner/less frequent wound canal passed slantwise outside from behind toward the front and towards the inside. In such cases usually was damaged one half the small arc of vertebra, moreover into the zone of decomposition frequently was involved one of the roots of small arc.

Still thinner/less frequent wound canal is passed almost vertically from bottom to top (Fig. 60), and in the single cases - downward. With such wounds was detected the extensive zone of decomposition, which could take several adjacent vertebrae. In these cases sometimes were damaged the roots of the small arcs of vertebrae, but always only one-sided. In such casualties the foreign body was located in the spinal canal considerably higher than place of its introduction into the spine.

The wounding shell in similar rare cases sometimes ricocheted within the spinal canal from a particular massive division of vertebra - from the root of its small arc or, it is more frequently,

from the body - and only the donkey of this it ceased its forward motion. On the basis of the X-ray anatomical analysis it was possible to establish/install the place of the introduction of foreign body into spinal canal and sector from which occurred the ricochet. With such all wounds there was an extensive damage of the contained spinal canal.

Exclusively rarely with the wounds of spine and II type spinal cord wound canal is passed to sagittal plane from the front back/ago. Such wounds, as a rule, were deposited by the fine/small metallic fragments, which possessed so considerable progressive/forward a force, that they proved to be in the condition to pierce the body of vertebra. In this case in the body of vertebra appeared the very narrow canal which was not detected in the X-ray photographs, and roentgenologically established only the presence of foreign body in the spinal canal (Fig. 61).

The wounds of spine and II type spinal cord in the majority of the cases were deposited by the metallic fragments of different origin, thinner/less frequent - by bullets. Rarely in the spinal canal were detected several foreign bodies.

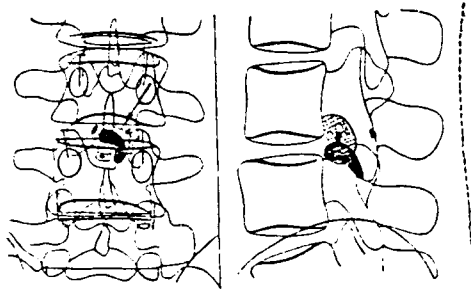


Fig. 59. Anatomical schemes from the X-ray photograph of the lumbar division of spine wounded P. Blind-end bullet wound of lumbar region. Breaking up of the left lower joint extension of the III lumbar vertebra. In the left half spinal canal the deformed bullet, two fine/small metallic foreign bodies several bone fragments. Spinal canal at this level is shaded (it is shaded into the cell). The presence of foreign body in the spinal canal testifies about the wound of II type spine. Comparison with clinical data shows that the wound canal passed in the sagittal plane horizontally from behind in advance.

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Usually in this case was established the presence of the even several foreign bodies, which were being arranged/located paravertebrally. In such casualties were always considerably destroyed the small arcs one - two vertebrae.

Very important moment/torque in the analysis of the damages of spinal cord with II type wounds was the value of foreign body. The complete destruction of spinal cord was doubtless, if there was a large/coarse foreign body, which performed the spinal canal (Fig. 60), or if in it were detected multiple foreign bodies. Fine/small fragments rarely penetrated the spinal canal and even the substance of spinal cord, without causing the extensive decomposition of the latter (Fig. 61).

Thus, with these two groups of II type wounds it seemed possible on the basis of roentgenological data to compose judgment about the degree of the damage of spinal cord. However, in the majority of casualties of this type were detected the sufficiently large/coarse foreign bodies, which occupied the significant part of the spinal canal, but they did not nevertheless perform by its rear sight (Fig. 59). In similar cases on the basis of roentgenological data it was not the possible to compose distinct representation about the degree of the damage of spinal cord. This was established on the basis of neurologic data or only during surgical intervention.

High value for the preliminary judgment had a refinement of localization of foreign body in the spinal canal that was conducted

roentgenatomically. Foreign bodies, located in the front/leading division of vertebrate canal, usually considerably destroyed spinal cord, because the latter is located near the front/leading wall of spinal canal and is fixed/recorded in this region by the spinal rootlets, which emerge through the intervertebral apertures. In the posterior division of spinal canal, between its wall and dural sack, is located venous web/plexus and fatty cellulose.

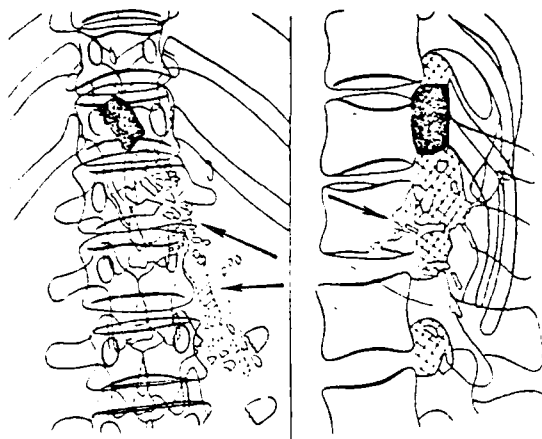


Fig. 60. Anatomical schemes from the X-ray photographs of lower-thoracic and lumbar division of spine wounded T. Blind-end fragmentation wound of left nates. The wound of spine and II type spinal cord, inflicted by the fragment which fills spinal canal at the level of XII thoracic vertebra. In the X-ray photographs is outlined entire wound canal. The wounding shell approached the spine from below to the left, after destroying the left cross extensions of the II, III and IV lumbar vertebra. Foreign body was inserted into the spinal canal through the region of the left intervertebral joint between the I and II lumbar vertebra (this sector was shown by arrow/pointer) and the left root of small arc of the I lumbar vertebra. Foreign body made in the spinal canal internal ricochet from the posterior body surface of the I lumbar vertebra and, after being guided upwards, it interrupted forward motion at the level of

the XII thoracic vertebra. About the ricochet testifies the breaking up of the posterior division of body of the I lumbar vertebra (it is noted by arrow/pointer) and the expansion of spinal canal at this level. Spinal canal in region of the I lumbar vertebra contains bone fragments. The lumen of the spinal canal is shaded at the level from the XII thoracic to the II lumbar vertebra (this region is shaded into the cell). In the left half lumbar region are discovered the gas bubbles which are located in the wound canal (they are shaded and shown by dual arrow/pointer) and in surrounding soft tissue (gas bubbles are shaded), which indicates the presence of anaerobic infection.

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Furthermore, the dural sack is not fixed/recorded in this division and can be displaced toward the front. Therefore even considerable foreign bodies, located in the posterior division of spinal canal, rarely directly damaged dural sack and spinal cord, and they more frequently only squeezed it.

However, with this localization of foreign body it was necessary to consider the possibility of a deeper introduction of the bone fragments which were forced; toward the front by the shell, which were stopped in the posterior division of spinal canal. Bone



fragments sometimes crossed/intersected spinal canal and destroyed its contents. With the wounds of the lumbar and neck division of spine such bone fragments were outlined well in the lateral X-ray photographs; in the thoracic division they were revealed/detected less distinctly as a result of the layering to the spinal canal of the image of edges/fins.

The small-gauge bullets, which penetrated in the intradural space or being located in the softened substance of spinal cord, are inclined to accept vertical position basis or, it is thinner/less frequent, by point down. This as "drop" position/situation of bullet was the straight/direct symptom of its intradural localization. The bullets, which were being disposed of thus, I could be moved in the intradural space usually in cranio-caudal direction and it is considerably thinner/less frequent in the reverse. The metallic fragments of different origin, which were being found in the intradural space, were displaced in it rarely.

Similar transfers were the reliable, but very rare and sufficiently late symptom of intradural localization of foreign body. In all remaining cases intradural localization of foreign body could not be established/installed with the full/total/complete confidence on the basis of roentgenological data.

III type of the wounds of spine and spinal cord. The wounds of spine and III type spinal cord appeared with the perforating and blind wounds of body or neck, which were with respect to the spine more frequent tangents and it is thinner/less frequent blind. Wound canal usually is passed to frontal plane concerning toward the posterior wall of spinal canal or it was forwarded slantwise, concerning to the lateral division of spinal column.

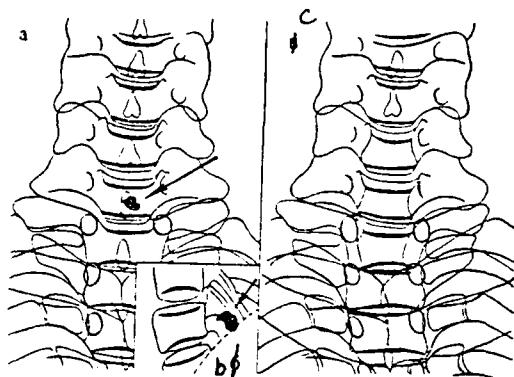


Fig. 61. Anatomical schemes from the series of the X-ray photographs of the lower unit of the neck division of spine wounded Ch. Blind-end fragmentation wound of the left half neck in its lower-front/leading external sector. During the primary x-ray examination (a, b) the violation of the integrity of the bone division of spine is not established/installed. In the spinal canal at the level of VII neck vertebra is discovered metallic foreign body to the left and toward the rear from the center of the spinal canal (it is shown by arrows/pointers), which made it possible to diagnose the wound of II type spine. Judging by the localization of wound on the skin, shell traversed body of the VII neck vertebra, forming in it the narrow canal which roentgenologically not explained. During surgical intervention the foreign body was extracted from the substance of spinal cord. In 1 1/2 months with control roentgenological study (c) is determined the defect of the posterior divisions of small arc of

the VI, VII neck and I thoracic vertebra after laminectomy. Foreign body is absent.

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With the blind-end wounds of a spine of this type wound canal is passed to sagittal plane from behind in advance or slantwise from behind outside toward the front and towards the inside. Foreign body most frequently destroyed the posterior division of the small arc of vertebra and was established among its fragments. Considerably thinner/less frequent it was introduced in the posterior sector of the body of vertebra, damaging thus the front/leading wall of spinal canal. With the blind-end wounds of III type spine foreign bodies they were located in the walls of spinal canal, but they did not come forward in it.

Thus, with the wounds of spine and III type spinal cord most frequently was destroyed the posterior wall of spinal canal, somewhat thinner/less frequent - its one side wall and very rarely - front/leading wall. Because of this by the straight/direct roentgenological symptoms of wounds of this type they were: 1) the full/total/complete state of preservation of the roots of the small arc of vertebra in the presence of decomposition posterior (Fig. 62) either, less frequent, the front/leading wall of spinal canal even 2)

the one-sided damage of the root of small arc of one (Fig. 63) or, less frequent than several adjacent vertebrae.

The size of the zone of the damage of spine with these wounds very varied. More frequently were observed the insignificant breaks of any sector of the small arc of vertebra. However, with the tangential wounds, which go along the spine, rarely appeared the extensive decomposition of the posterior divisions of the small arcs of several vertebrae, which were relating to the wounds of this type.

Bone fragments with III type wounds usually were not displaced into the spinal canal, in consequence of which the image of the latter in the lateral X-ray photographs proved to be unshadowed.

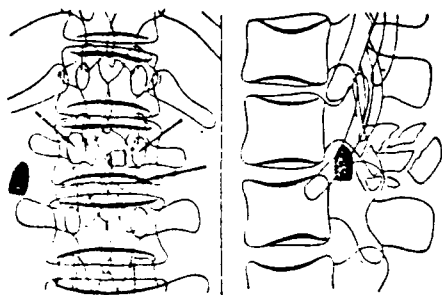


Fig. 62.

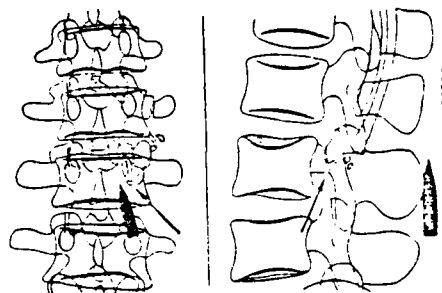


Fig. 63.

Fig. 62. Anatomical schemes from X-ray photographs of upper-lumbar division of spine wounded K. Blind-end bullet wound of the left half lumbar region. During the primary x-ray examination is discovered the breaking up of entire posterior division of small arc of the I lumbar vertebra (it is shown by dual arrow/pointer), together with the lower joint and awned extensions. Bone fragments are displaced insignificantly. Both roots of the small arc of this spine are preserved (they are noted by arrows/pointers). Spinal canal is not shaded. Automatic bullet is arranged/located paravertebrally, between the right cross extensions of the I and II lumbar vertebra. The decomposition of the posterior wall of spinal canal with the retention/preservation/maintaining of integrity of both roots of arch of vertebra testifies about the wound of III type spine.

Fig. 63. Anatomical schemes from X-ray photographs of lumbar division

of spine wounded S. Blind-end bullet wound of left nates. With primary roentgenological study is established/installed the crushed break of the left root of small arc of the III lumbar vertebra (it is shown by arrows/pointers) with the insignificant displacement of scrap. The corresponding upper joint extension was separated in the basis and was wholly displaced towards the outside. The left lower joint extension of the II lumbar vertebra also splintered, left cross extension of this vertebra is broken. Spinal canal is not shaded. Rifle bullet is arranged/located to the left and toward the rear from the awned extension of the III lumbar vertebra under the skin. The presence of the decomposition of one root of the arc of vertebra indicates the wound of III type spine.

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Less frequent with such wounds was observed the considerable displacement toward the front of the fragments of the posterior wall of spinal canal. In this case the dural sac was pressed in rare cases toward the front and only destroyed with bone fragments. In such casualties in the lateral X-ray photographs of spine was detected the blanket of spinal canal and the presence in it of bone fragments.

The wounds, which are characterized by the break of the posterior wall of spinal canal with the

retention/preservation/maintaining of the integrity of the root of the small arc of vertebra, were most the lungs of all damages of the III type. Is more serious the decomposition of the lateral wall of spinal canal. In such cases the zone of the break sometimes converted/transferred from the root of small arc in the adjacent sector of the body of vertebra. Most heavy were the damages of the front/leading wall of spinal canal.

IV type of the wounds of spine and damages of spinal cord. Straight/direct roentgenological symptoms of wounds of this type was the damage only of such divisions of spinal column which do not participate in the formation of the walls of spinal canal.

In the lumbar and neck division of the spine most of unit were observed the wounds of lateral ones and is thinner/less frequent than ventral ones the sector of the bodies of vertebrae and intervertebral disks. In this case they were encountered both the blind-end (Fig. 64) and tangential wounds of the bodies of vertebrae. The analogous wounds of thoracic vertebrae were observed extremely rarely, since in the majority of the cases such wounds were not consistent with the life in view of the decomposition large vessels.

The isolated/insulated breaks of the cross extensions of all vertebrae relate to IV type wounds. These breaks most frequently were



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encountered in the lumbar and thoracic division of spine (Fig. 65).  
Are usual they originated with the blind-end wounds of chest and  
abdominal area.

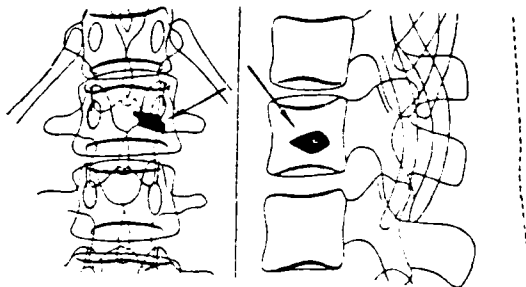


Fig. 64.

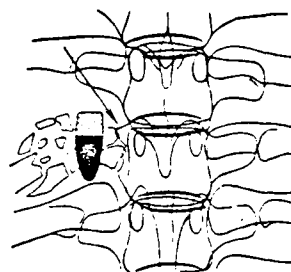


Fig. 65.

Fig. 64. Anatomical schemes from X-ray photographs of upper-lumbar division of spine wounded K. Blind-end fragmentation wound of the left half lumbar region. During the primary x-ray examination is discovered the metallic foreign body, which was incorporated in the left half body of the I lumbar vertebra (it is shown by arrows/pointers), without having injured the walls of spinal canal. The state of preservation of the walls of spinal canal testifies about the wound of IV type spine.

Fig. 65. Anatomical scheme from posterior X-ray photograph of thoracic division of spine wounded B., which obtained blind-end bullet wound into back. During the primary x-ray examination is established/installed the breaking up of the right cross extension of the V thoracic vertebra (it is shown by arrow/pointer). The remaining divisions of spinal column are not changed. Furthermore, is

discovered the crushed break of head and neck/journal of right V edge/fin. Automatic bullet is arranged/located radically of right lung. Bullet repeats the respiratory movements of the lung, in consequence of which its image is dual (shaded - the less intense sector of the image of bullet). The presence of the isolated/insulated decomposition of cross extension indicates the wound of IV type spine.

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With these wounds the snell is passed paravertebrally to sagittal plane from behind in advance and frequently was caused the damage of the organs/controls of the areas indicated. With the bullet breaks of the cross extensions of neck vertebrae invariably/unchangedly was damaged spinal artery. The latter with the blind-end wounds was sometimes tamped by quite foreign body, which were incorporated in this sector.

The isolated/insulated breaks of the awned extensions of lumbar vertebrae and the II and VII neck always related to IV type wounds (Fig. 66). In the thoracic division of spine awned extensions usually were destroyed together with the posterior sector of the small arc of vertebra, in consequence of which appeared III type wound. Then occurred with the breaks of the awned extensions of the III, IV, and

V neck vertebra, because these extensions have insignificant value and take direct part in the formation of the posterior wall of spinal canal.

The awned extension of the VI neck vertebra varies in its manifestation and becomes similar by that by sometimes arranged/located above, to the sometimes arranged/located below vertebrae. In the first cases its isolated/insulated breaks related to III type wounds, the secondly - to IV type wounds. The variant of the spinous extension was established on the basis of its bifurcation in the first cases and the absence of this bifurcation the secondly, which distinctly is revealed/detected in the posterior X-ray photographs.

The breaks of posterior arc Atlanta were always III type wounds. The encountered rarely isolated/insulated breaks of front/leading small arc Atlanta related to IV type wounds, since this small arc does not directly form the wall of spinal canal. The very rare isolated/insulated breaks of the upper joint extensions of lumbar vertebrae also related to IV type wounds.

With the wounds of IV type spine especially high value had the breaks of the bodies of vertebrae as a result of the fact that they were encountered most frequently and they were inclined they were

inclined to be complicated by osteomyelitis.

V type of the damages of spinal cord. The damages of V type spinal cord, for which is characteristic the absence of the violation of the integrity of spine, are most difficult for the diagnosis. This type of wound was purely clinical concept, since with it was detected no roentgenological symptoms of wound of vertebra. Nevertheless the damage of a spinal cord of this type could not be identified without the comparison of clinical data with the roentgenological ones. Corresponding diagnosis was placed when the presence of the neurologic symptoms of the damage of spinal cord and the roentgenological reference points of the wound of spine are absent,. The diagnosis of wounds of this type is most difficult and critical. Diagnosis was placed after the careful x-ray examination of spine not only at that level which corresponded to neurologic symptoms, but also by all above and, which is most important, below arranged/located levels.

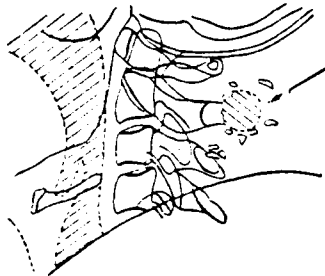


Fig. 66. Anatomical scheme from the lateral X-ray photograph of the neck division of spine wounded R. Perforating bullet wound of posterior-upper division of neck in the frontal plane. Crushed break of the awned extension of the II neck vertebra. The remaining divisions of spine are not damaged. Distinctly is revealed/detected the wound canal, filled with air (it is shaded and shown by arrow/pointer). Prevertebral soft tissues normal (they are shaded). The presence of the isclated/insulated break of the awned extension of the II neck vertebra testifies about the wound of IV type spine.

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Otherwise could be identified the direct wound of spine and spinal cord which was located considerably lower than region of damage, established/installed neurologic. This could occur only when the considerable softening of the lying above sections of spinal cord is present.

The damages of V type spinal cord most frequently were observed with the perforating paravertebral wounds. Considerably more rarely were encountered blind-end wounds with the localization of foreign body near the spine.

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## CHAPTER VI.

### GENERAL PRINCIPLES OF THE TREATMENT OF BULLET WOUNDS OF SPINE AND SPINAL CORD.

Development of therapeutic aid by that wounded the spine and the spinal cord for the time of the Great Patriotic War.

V. A. Znamur, Doctor of medical sciences, Professor.

A question about the treatment of the bullet wounds of spine and spinal cord during the Great Patriotic War was one of the important and difficult sections of military field neurosurgery. The specific gravity/weight of the wounds of spine and spinal cord among all wounds of nervous system is given in Table 14.

In different stages the evacuations of the wound of spine and spinal cord were from 7.6 to 16.00/o of all wounds of nervous system. The wounds of spine and spinal cord were heaviest, which required sometimes very complex surgical interventions both on the spine (soft tissue, bone, spinal cord and its shells) and on the adjacent



organs/controls or the tissues (combined wounds).

Although the basic condition/positions of the treatment of the wounds of spine and spinal cord at the beginning of the Great Patriotic War corresponded to the level of neuro-surgical knowledge of those days, in view of their complexity and impossibility of full/total/complete putting into action in the circumstances of mobile warfare, they were introduced gradually and considerably they were changed.

Table 14.

(1) Автор	(2) Годы	(3) Ранения позвоночника и спинного мозга (в процен- тах)
(4) Э. И. Гейманович . . . . .	1914—1918	16,0
(5) Н. Зелинский . . . . .	1945	10,0
(6) Я. И. Файнзилберг . . . . .	1946	7,6
(7) М. П. Постолов . . . . .	1946	15,0
(8) В. И. Шамоу . . . . .	1944	10—15,0
(9) А. С. Орловский . . . . .	1946	10—15,0

Key: (1). Author. (2). Years. (3). Wounds of spine and spinal cord (in percentages). (4). Z. I. Geymanovich. (5). N. Zelinskiy. (6). Ya. I. Faynzil'berg. (7). M. P. Postolov. (8). V. N. Shamov. (9). A. S. Orlovskiy.

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From the first days of the Great Patriotic War basic requirement in the organizational and therapeutic work of field medical service was urgent and steady satisfaction of the basic conditions of combat field surgery, which include: 1) timely carrying out/removal from the field of breakage, 2) correct classification and urgent evacuation in the designation/purpose, 3) early prophylaxis of infection (primary bandage), sufficient immobilization and timely surgical and specialized aid.

During the first two years of Great Patriotic War (1941-1942) of operations/processes on the spine as a result of the severe conditions of mobile warfare at many fronts they produced a little. Compared with the operability of the wounds of skull and brain the operability of the wounds of spine and spinal cord remained low.

Thus, according to the data of the hospital basis of the rear, operability for the years of war was the following.

Given data clearly show the increase of surgical activity with the wounds of spine and spinal cord.

Those served as basic leadership/manual on the military field surgery for the doctors of this period of "indication on the military field surgery" (1941 and 1942) defined the boundaries of the operability of those wounded into the spine and the spinal cord by the following position/situation: "on DMP and in PPG is performed only the usual primary surgical processing of wound. Operations/processes apropos of incomplete interruption and compression of spinal cord are conducted in the specialized hospital GBA or the rear hospital".

Although already during the war with the White Finns was established/installed the groundlessness and even harm of the

surgical processing of the wound of soft tissues, nevertheless during the first years of war it was conducted in a considerable quantity. Thus, according to the data of reports of one of the fronts (N. I. Ishchenko), the primary processing of wounds in the stages of evacuation was following for the first half of 1943: on DMP - 40.00/o, in the hospitals of army - 13.20/o, in the hospitals of the rear - 8.00/o. On the months to DMP this it was distributed as follows:

(1) Месяц	(2) Январь	(3) Февраль	(4) Март	(5) Апрель	(6) Май	(7) Июнь	(8) Средняя
(9) Процент . . .	14,8	50,0	54,7	68,0	49,0	21,3	40,0

Key: (1). Months. (2). January. (3). February. (4). March. (5). April. (6). May. (7). June. (8). Average/mean. (9). Percentage.

As can be seen from given data, the primary processing of wounds (especially during the first years of war) was performed comparatively frequently, which frequently considerably impeded radical surgery on the spine and the spinal cord in further stages of evacuation.

Table 15. Operability of those wounded the spine on the years of war (data of the hospitals of the rear in the percentages).

(1) Год войны				(6) Средняя
первый (2)	(3) второй	(4) третий	(5) четвертый	
9,4	20,3	29,2	41,1	25,0

Key: (1). Year of war. (2) the first. (3) the second. (4) the third. (5) the fourth. (6). Average/mean.

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Therefore among the medical officers was encountered all more such, who completely realized the uselessness of the carving of the wound of soft tissues and gradually they rejected it, increasingly more frequently resorting to the early radical perfecting of wound.

At the II plenum of the hospital council of Narkomzdrav USSR (1942) A. N. Bakulev, A. Yu. Sozon-Grozevi and V. A. Gusynin supported the possibility of radical intervention on the spine with an unhealed wound, arranged/located paravertebrally, even with the imposition of anechoic suture (A. N. Bakulev). In the resolution of plenum is emphasized the value of early surgical interventions with the bullet wounds of spine and spinal cord.

From the second half the Great Patriotic War began considerably to increase the activity of the surgeons and neurosurgeons in the relation to the surgical treatment of the wounds of spine and spinal cord. The substantiated in no way advantage of conservative treatment began to undergo radical review. N. N. Burdenko, A. N. Bakulev, A. L. Polenov, later V. N. Shamov et al. especially persistently underscored the effectiveness of early surgical intervention.

In the second half war the victorious advance of Soviet army forward created conditions for the advancement at the beginning of the combat operations/processes of the specialized aid far forward. Thus, already during the Belorussian, L'vov and many other operations/processes even the front line specialized neuro-surgical agencies advanced at the beginning of combat operations/processes into the army area, which created favorable conditions for a maximally timely and radical operational processing of such casualties.

By this time the organization of neuro-surgical aid obtained the following completely completed and ordered form.

1. Neuro-surgical separation/section of specialized PPG of hospital basis of army was serviced/maintained by neuro-surgical group of ORMU [separate medical reinforcement company]. In their each

army usually were organized two on the different flanks.

2. Neuro-surgical separation/section of GBF or special hospitals (less frequent).

3. Neuro-surgical separation/section or hospital of deep rear.

According to the data of a number of the authors, in the front line and rear neuro-surgical hospitals those wounded the spine and the spinal cord occupied 10.0-15.00/o of entire bed fund (A. S. Orlovskiy).

In resolution of the VI session of neuro-surgical advice/council together with the scientific medical council of Narkomzdrav USSR (January 1944) on the basis of the accumulated practical experience already persistently emphasized the need for early surgical intervention with the bullet wounds of spine and spinal cord and taking of complex therapeutic measures with the attraction of therapist, urologist, orthopedist, physiotherapist, specialist in the therapeutic exercise, and also roentgenologist and bacteriologist. At the same session underwent comprehensive discussion questions of prophylaxis of different complications, especially bedsores and complications from the side of the urination system.

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In the resolution on the report A. N. Bakuleva was noted role and problems of the separate stages of evacuation in the treatment of the spinal casualties. In this case it was proposed to perform radical operation/process in the specialized hospitals of GBF, leaving for the institutions of army and army area only the problem of prophylaxis of urological complications, by the imposition of urinovesical fistula in the appropriate cases and the fastest evacuation of such casualties according to the designation/purpose into the front rear.

Important in the decisions of session was the requirement of conducting the "principle of division into districts" in the treatment of the wounds of spine, i.e., the requirement to guide them during the evacuation for further treatment into the specific specialized agencies of the deep rear, connected with each front line area. This principle of division into districts, it is doubtless, contributed to the retention/preservation/maintaining succession in the line-of-communication treatment of casualties with the damage of spinal cord.



Not less important in resolutions of session was the requirement of the improvement of the specialized aid by the wounded route/path of the creation of separations/sections for the wounded the spine and the spinal cord in the specialized evacuation hospitals fronts with their proper equipment and manning the appropriate states/staffs with the attraction for the work in them of the neuro-surgical groups of reinforcing.

Thus, the advisability of surgical intervention on spine and contents of spinal canal in the earliest possible periods after wound already to the second half the Great Patriotic War was acknowledged by Soviet neurosurgeons, surgeons and neuropathologists.

This change in the views of neurosurgeons pronounced in the considerably increased activity during the treatment of the bullet wounds of spine and spinal cord. Neurosurgeons' vast majority already on the basis of personal experiment/experience arrived at the conclusion about use and even need for the early operations/processes, which play very prominent role in the general/common/total plan/layout of the treatment of the wounds of spine and spinal cord. Thus, according to the data of one hospital basis of the near rear, a quantity of laminectomies from year to year was raised: the first year - 8.00/o, the second year - 10.00/o, the third year - 11.00/o, the fourth year - 30.00/o, average - 14.70/o.

Along with this was widely applied the superpubic section of the bladder - cystostomia as the method of prophylaxis of urinary/urine infection. According to the data of the same hospital basis, in the second half-year of 1944 cystostomia was superimposed by 6.50/o all of those entered, without considering those, coma it it was superimposed in the foremost stages. According to the data of GBA, in 1945 during the Prussian operation/process of cystostomia it is superimposed into 100.00/o of cases of the wounds of spinal cord with the clinical picture of the full/total/complete violation of its conductivity.

The expansion of surgical aid by that wounded the spine both in the army and in the front line area brought also to the review of the existed instruction of the Ministry of Public Health of the USSR. In the instructional instructions of the Ministry of Public Health of the USSR (1944) are given differentiated indications relative to the surgical classification of casualties with the damage of spine on DMP and in KhPPG of the first line for the establishment of the order of evacuation to specialized KhPPG. In them it was recommended wounded the spine and the spinal cord possible rapidly to evacuate into the army rear, detaining in the institutions of the army area only of nontransportable ones and casualties, who were needing urgent

interventions from the vital readings (more frequent combined wounds of spine and organs/controls of chest or abdominal area). Were established/installed readings to early surgical interventions and were given indications relative to prevention of complications, in particular, prophylaxis and treatment of the infection of the urinary tracts: "the drainage of bubble by superpubic section is the most accurate method of struggle with the infection of urinary tracts".

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For the immobilization of spine during the evacuation within the time the wars put to use different improvised wooden or wire splints (Fig. 67), thinner/less frequent by gypsum beds. For the purpose of the reliable immobilization of spine during the transportation were even designed different stretchers (Figs. 68-71).

Within the time of the Great Patriotic War progressively were developed the views on the surgical perfecting technique of the wounds of spine and of spinal cord, reading and contraindication to laminectomy, and also views on prophylaxis and treatment of different complications, connected with the damage of spine and spinal cord.

It is necessary to note that, together with the urgent practical problems of treatment, in all institutions of the medical and

sanitary service of Soviet army they conducted also the numerous scientific investigations of the violations, connected with the damage of spine and spinal cord. The results of the investigations of the neurophysiologists, neurohistologists, pathophysiologists, bacteriologists, pharmacologists and clinicians during the war were already to a considerable extent used for the purpose of the treatment of the wounds of spine and spinal cord.

The short survey/coverage of the vast made work for the time of the Great Patriotic War cannot encompass all details of the organization of therapeutic aid by that wounded into the spine and the spinal cord in all stages of evacuation. Are here illuminated only the basic and fundamental condition/positions, which served as basis to a radical change in the views on the problem of surgical aid by that wounded into the spine and the spinal cord.

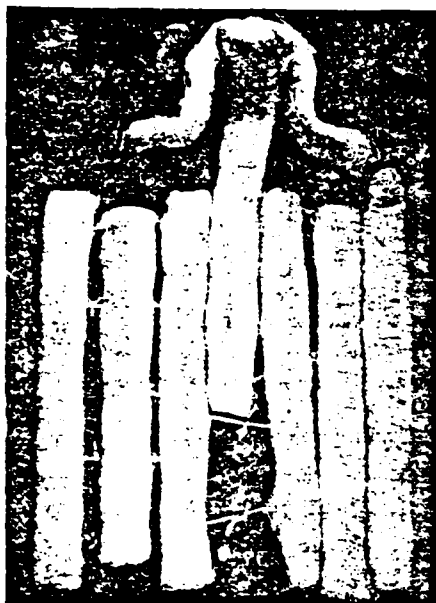


Fig. 67. Immobilization of the neck division of spine by wire splints.

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Fig. 68.



Fig. 69.

Fig. 68. Underneath panel with head rest to A. S. Orlovskiy's stretchers.

Fig. 69. Stretchers are prepared for arranging casualty.

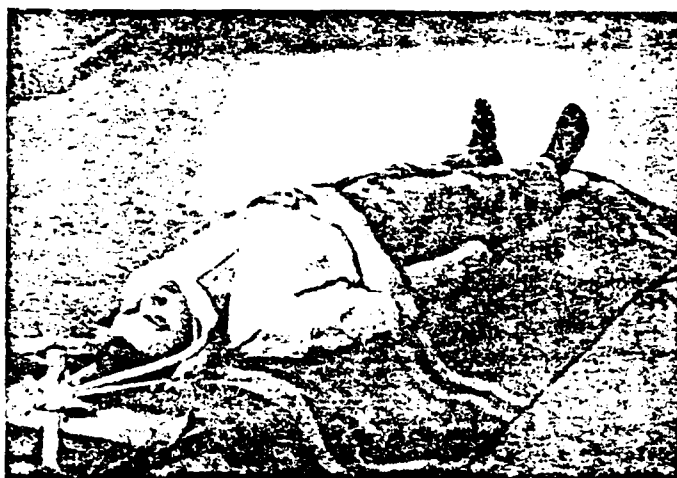


Fig. 70. Arrangement of casualty.

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Soviet military field neurosurgery in the Great Patriotic War overcame the propagandized in the foreign countries obsolete views about the advisability of the conservative treatment of the bullet wounds of spine and spinal cord and it replaced with their active methods, after engaging rightfully the first place in the world.

Soviet neurosurgeons' experience in the Great Patriotic War refuted the established on the experiment/experience of previous wars opinion about the hopelessness of those wounded the spine and the spinal cord and showed that as a result of surgical activity during

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the treatment of such casualties - early laminectomy, improvement in the departure/attendance, prophylaxis and treatment of different complications - it is possible to increase chances for the favorable outcome even in the cases, which were being considered earlier hopeless.



SURGICAL METHODS OF TREATMENT OF BULLET WOUNDS OF SPINE AND SPINAL CORD.

D. G. Goldberg, Candidate of the medical sciences, docent.

The treatment of the bullet wounds of spine and spinal cord during the Great Patriotic War was reduced to the following:

- a) to the primary surgical perfecting of wound, i.e., to the removal/distance of all nonvital tissues from the wound as the measures of prophylaxis and struggle with the infection;
- b) to the elimination of the compression of spinal cord by the removal/distance of bone fragments, foreign bodies, etc.; c) to prophylaxis and treatment of different complications, trophic disorders, connected with the damage/defeat of spine and spinal cord.

The experience, acquired by the collective of the military neurosurgeons, showed that most effective singularly radical in direction indicated above treatment in all stages of evacuation was the surgical (surgical) treatment in combination with the series/number of medicinal/medicamentous substances, sulfanilamides, antibiotics and different physical therapy measures.

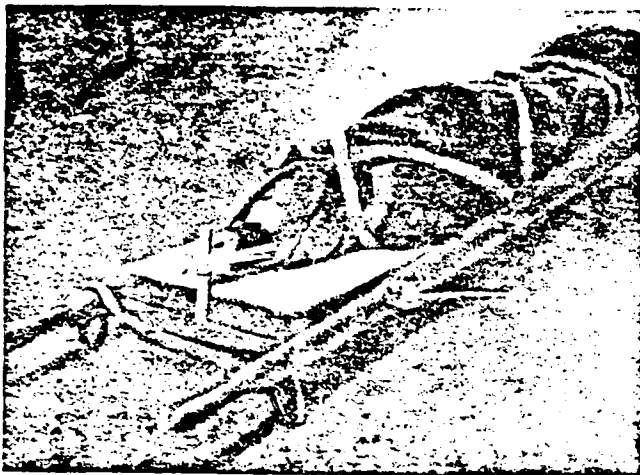


Fig. 71. Casualty is prepared to the evacuation.

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The specificity of operational receptions/procedures with the wounds of spine and of spinal cord, connected with the careful neurologic clinico-surgical and roentgenological examination/inspection of casualties, more prolonged hospitalization in the post-operation period in comparison with other wounds determined character/nature and volume of surgical intervention in different stages. In this case in the army area, depending on sanitary-tactical circumstances, the presence of the substances of evacuation, surgical interventions either in no way were conducted or were conducted only as measures struggles with the infection of wound (primary perfecting of the wound of soft tissues, removal/distance of

fragments). Special neuro-surgical interventions were conducted in the hospitals of army and front line area.

The distribution of different surgical interventions apropos of the wound of the spine and spinal cord in different stages of sanitary evacuation during the period of the Great Patriotic War is evident from Table 16.

To other institutions are related the hospitals of the deep rear and civil institutions of the front line areas and deep rear.

The analysis of data, given in Table 16, shows that perfecting the wounds of soft tissues and removal/distance of bone and metallic fragments were performed mainly in the army area, while laminectomy, almost as a rule, it was conducted in the therapeutic institutions of army and front line area.

Thus, with the wounds of spine and spinal cord the character/nature of surgical intervention by its volume extremely varied, beginning from the dissection of wound to complex surgical interventions with the autopsy of solid cerebral shell. First surgical intervention could be produced on DMP, and the second required narrower than special organization and proper conditions.

It would seem completely logical to divide both means of interventions in the stages of evacuation. However, the experiment/experience of war completely convincingly showed the groundlessness of this assumption, since the produced dissection of the wound of soft tissues, which was complicated by infection, always detained for the more or less considerable period surgical intervention on spine and contents of spinal canal or required special approaches.

Table 16. Distribution of surgical interventions in character/nature and stages of evacuation (in the percentages to a total number).

(2) Характер оператив- ного вмешательства	(1) Этапы эвакуации				(5) Всего
	ДМП	(3) специализированные госпитали		(4) прочие учреждения	
		ГБА	ГБФ		
(6) Расчленение раны .	78.6	15.8	3.1	2.5	100.0
(7) То же с удалением костных отломков	49.3	24.5	9.2	17.0	100.0
(8) То же с удалением иеротных тел .	39.9	24.0	17.2	18.9	100.0
(9) Ламинэктомия . . .	7.6	40.5	27.8	24.1	100.0

Key: (1). Stages of evacuation. (2). Character/nature of surgical intervention. (3) the specialized hospitals. (4) other institutions. (5). In all. (6). Dissection of wound. (7). The same with removal/distance of bone scrap. (8). The same with removal/distance of foreign bodies. (9). Laminectomy.

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However, the impossibility of rendering to the proper neuro-surgical aid in the army area, it is doubtless, determined certain elongation of the periods of radical intervention in connection with the delay of casualties in the intermediate stages of evacuation. In the earlier periods surgical interventions were conducted on DMP and were reduced, as is evident from Table 16, mainly to the dissection of wounds and the removal/distance of

fragments. A more precise characteristic of periods of surgical interventions in the stages of evacuation is represented in Table 17. From the comparison of data of Tables 16 and 17 it is evident that in essence radical surgery on spine and contents of spinal canal were conducted in the therapeutic institutions of army and front line area after 10 days. The latter fact was explained partially by the delay of the evacuation of casualties or by the complication after the already produced perfecting of the wound of soft tissues in the therapeutic institutions of army area, and also by the fact that the wounds of spine and spinal cord required the more prolonged periods of observation for refining the character/nature of the damage of spinal cord.

Specialized aid by these casualty was rendered in the neuro-surgical separations/sections of the hospitals of army (GBA) or front line (GBF) area and in a small number in the institutions of the deep rear. In all of these establishments, besides the neurosurgeons, worked the doctors of adjacent specialties (therapist, urologist, roentgenologist, orthopedist, physiotherapist). Highly efficient aid by that wounded the spine rendered the civil/civilian therapeutic institutions, located both in the front line areas and in the deep rear.

On GBF and in the deep rear with the concentration of a

considerable quantity of the neuro-surgical casualties were created special separations/sections or even were secreted special hospitals for those wounded the spine.

The latter fact was very important, since treatment and care of such casualties required the increased staffs of the service medical personnel as well as the corresponding armament and instrumentation with the objects/subjects of departure/attendance, laboratory armament and so forth, etc. It is doubtless, under these conditions had a value the specialization of roentgenologist, physiotherapist, urologist, orthopedist and other specialists, who considered all details during diagnosis and treatment of the wounds of spine, which had sometimes vital value for the casualty.

Table 17. Periods of surgical interventions in different stages of evacuation.

(1) Этап эвакуации	(2) Сроки оперативных вмешательств					(8) Всего
	(3) в первый день	(4) на 2-3-й день	(5) на 4-9-й день	(6) на 10- 30-й день	(7) позже 30 дней	
(9) Войсковой район (МСБ и МСР)	80,4	16,7	1,5	0,9	0,5	100,0
(10) Армейский район (ХИПГ)	36,0	32,0	13,5	11,4	2,1	100,0
(11) Специализированные госпитали (ГБА)	4,9	6,6	8,2	31,1	49,2	100,0
(12) Специализированные госпитали (ГБФ)	8,2	15,0	15,4	27,7	23,7	100,0
(13) Прочие лечебные учреждения	7,7	4,5	7,3	19,5	61,5	100,0

Key: (1). Periods of surgical interventions. (2). Stage of evacuation. (3) during the first day. (4) on the 2-3rd day. (5) on the 4-9th day. (6) on the 10-30th day. (7) it is later than 30 days. (8). In all. (9). Army area (MSB and MSR). (10). Army area (PPG). (11). Specialized hospitals (GBA). (12). Specialized hospitals (GBF). (13). Other therapeutic institutions.



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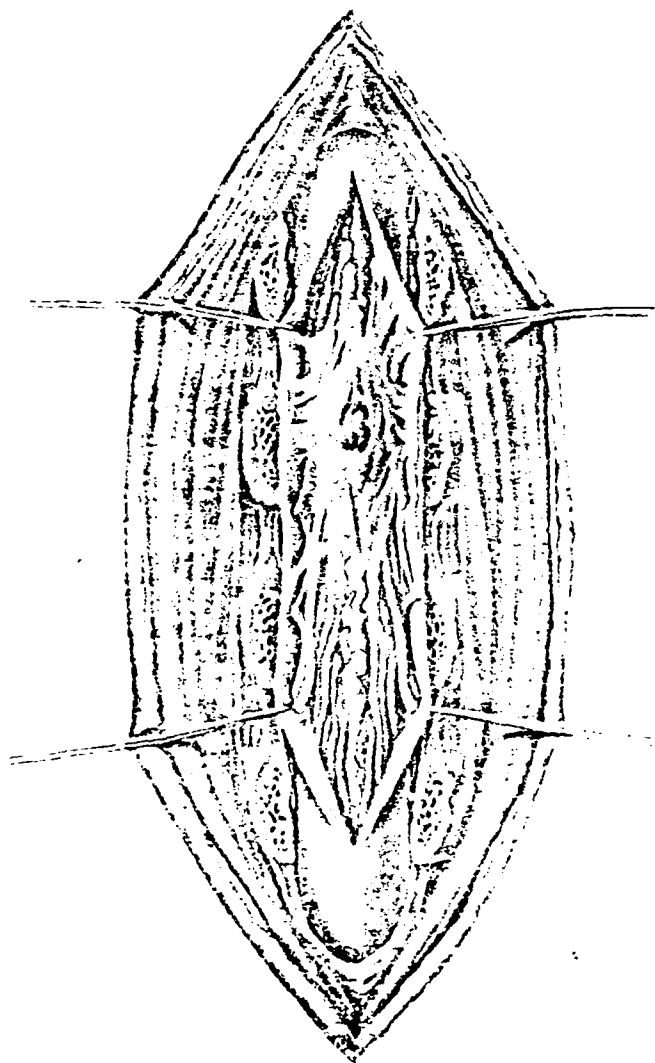


Fig. 72. Blind-end fragmentation penetrating wound of lower-thoracic division of spine. Focus adhesive arachnoiditis around the foreign body. Preparation VMM No 1447. (Artist T. V. Belyayeva).

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Targets and problems of radical surgery consisted not in the reduction of the anatomically destroyed units of spinal cord, but in the creation of most favorable conditions for reducing the conductivity of those divisions of spinal cord whose functions were disrupted as a result of the compression by foreign body, the tunicary intergrowth, edema, hemostasis and cerebro-spinal fluid and so forth (Fig. 72).

To remove the factors of the compression, which disturbs the function of spinal cord, is the basic problem of surgical treatment. When was detected the full/total/complete interruption of spinal cord, the suture of brain was not applied. If operation/process was conducted in the region of horse tail, then in the cases of the violation of the integrity of rootlets of the latter was shown the imposition on them of sutures.

Indications for laminectomy.

Indications for the surgical treatment of the bullet wounds of spine were placed afterward the comprehensive neurologic, surgical

and x-ray examination of casualties. Only summarizing all findings, it was possible to establish/install correct readings to the operation/process in each specific case.

As showed the experiment/experience of the Great Patriotic War, it was not possible readings to surgical intervention in the early period to substantiate only by data of neurologic clinic of wound, since in the sharp/acute and early period to differentiate the character/nature of the wound of the contained spinal canal it was frequently impossible. However, at the end of the early period or in the beginning of intermediate period neurologic investigation gave already valuable indications relative to changes in the spinal cord, its rootlets and shells. By this time usually were smoothed the phenomena of spinal shock, edema and bloating of spinal cord, more clearly were revealed/detected the actual sizes of the wound of spinal cord. Neurologic indications of increasing edema and compression of spinal cord under all conditions served as sufficient reading to surgical intervention, even urgent, if with the wounds of the neck division of spine appeared the difficulties of respiration (N. N. Burdenko, A. N. Bakulev et al.).

To solve a question about the presence of readings to surgical intervention considerably helped the surgical methods of the examination/inspection of casualty. Here first of all was involved

the inspection of wound and the possible analysis of the direction of the wound canal (see general/common/total unit, Chapter V).

Very important role played the roentgenological method of study. The latter in the absolute majority of the cases detected actual sizes and character/nature of the damage of spine, the level of wound to a considerable extent helped to create preliminary representation about the possible damages of spinal cord, freeing from the need to frequently wait the explanation of the dynamics of neurologic violations.

It is significant that each type of the wound of spine (according to N. S. Kosinskoy) was almost regularly escorted/tracked by the appropriate damage of spinal cord, which in combination with the data, obtained during the neurologic and clinico-surgical investigation of casualty, with the sufficient basis served as guide to action, in particular, in the determination of readings and contraindications to surgical radical intervention in the early and intermediate period of wound.

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The majority of the neurosurgeons and neuropathologists, being based on the experiment/experience of the Great Patriotic War,

arrived at the conclusion that by basic general/common/total reading to early laminectomy<sup>1</sup> was the perforating, blind-end or tangential penetrating wound of spine.

FOOTNOTE <sup>1</sup>. By early laminectomy is understood surgical intervention, produced from several days to 2 weeks after wound. ENDFOOTNOTE.

As supplementary ones to the general/common/total readings to early laminectomy with different wounds of spine they served:

- a) sharp/acute radicular pains;
- b) the blockade of liquor space, determined by liquorodynamic tests/samples;
- c) acute or ascending edema and bloating of spinal cord, especially with the wounds of neck division (danger in death from paralysis of respiration);
- d) liquorrhea; <sup>q</sup>e) the build-up/growth of the violations of the conductivity of spinal cord or horse tail;
- f) the appearing signs of focus meningitis, especially in those cases when wound did not undergo radical primary perfecting.

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In all doubtful, unclear and roentgenologically unconvincing cases better it was operate casualty than, waiting the refinements of diagnosis, to allow the onset of complications both from the side of the urinary tracts and other complications (pneumonia, bedsores, wound cachexia, etc.), which impeded subsequently conducting the operational intervention and represented threat for the life casualties.

During such readings the small unit of the casualties underwent operation/process without the considerable effect (anatomical interruption of spinal cord, contusion of spinal cord); however, these "error" they were purchased by the achieved sometimes positive results. The latter is especially important, if one considers that not always it was possible to roentgenologically establish/install presence in the spinal canal of the fine/small bone fragments, which disturbed the conductivity of spinal cord or horse tail. Sometimes the wounds, which were seeming paravertebral, in reality proved to be the tangential or perforating penetrating wounds of spine with the appropriate damage of spinal cord (horse tail). In the rare cases with the passage of the wounding shell through the intervertebral apertures or through the interosteal gaps/intervals the perforating and blind-end penetrating wounds of spine were not escorted/tracked

by the wound of vertebrae. Clinico-surgical analysis of these cases contributed to the refinement of readings to the early surgical treatment.

Of A. L. Polenov's figurative expression, even a least improvement in the disrupted functions is for that wounded the spine and the spinal cord the same, as for the blind light-perception. Under these conditions becomes clear certain expansion of readings to test laminectomy in the doubtful cases.

Thus, in the period of the Great Patriotic War readings to the operation/process in comparison with the installations of the surgeons of the first world war considerably were spread. As a result of experiment/experience were developed and detailed not only the readings to the surgical treatment, but also the periods of intervention.

More distinctly came to light also the forms of the wounds, with which radical surgical intervention (of type of laminectomy with the revision of the contained spinal canal) is not shown or even contraindicatedly.

According to these data, laminectomy is not indicated:

1) with the accurately established/installed clinically and roentgenologically by through penetrating wound of spine with the extensive destruction of vertebrae and the full/total/complete violation of the conductivity of spinal cord;

2) with the nonpenetrating wounds of spine with the damage of body or extensions of vertebra and the syndrome of contusion or jolt of spinal cord;

3) with the paravertebral wounds with the syndrome of contusion or jolt of spinal cord;

4) with the blind-end penetrating wounds of spine by the very fine/small foreign bodies (size/dimension in 1-3 mm) without any considerable damage of spine and with the rapidly smoothed violations of the conductivity of spinal cord (horse tail);

5) with the tangential penetrating wounds of spine with the insignificant damage to bone and without the expressed violations of the function of spinal cord.

Laminectomy is contrasted:



- 1) to the output/yield of casualty from the condition of traumatic shock;
- 2) in the combined wounds of spine and of chest or abdominal area and the respectively heavy condition of the casualty (hemothorax of small sizes/dimensions does not impede laminectomy);
- 3) with far visited complications from the side of the urinary tracts (cystopyelitis, pyelonephritis), during the development of septic process, with the onset of pneumonia;
- 4) with different intercurrent diseases, which to a considerable extent weight the general condition of casualty;
- 5) with far visited intoxication and wound cachexia;
- 6) during the considerable festering of wound in the zone of operating field;
- 7) with the unfavorable sanitary-tactical circumstances, which eliminates the possibility of hospitalization after operation/process;

9) during the insufficient equipment for conducting of wide surgical intervention and post-operation departure/attendance, and also with the impossibility of taking the necessary diagnostic measures, in particular, x-ray examination.

Periods of intervention. According to the experiment/experience, acquired during the Great Patriotic War, Soviet neurosurgeons' absolute majority arrived at the conclusion about the advantage of early operations/processes.

Is at the present time in the sufficient measure explained the harm of the prolonged compression of spinal cord, which leads to the development of the focus or diffuse necroses of spinal cord, the violation of liquor, lympho- and blood circulation, and also to the toxic effect of the fission products of spinal cord on the preserved divisions of spinal cord. Are established/installed the dangers the infections, connected with the stay of bone fragments and foreign bodies in the spinal canal, etc.

The most essential factor, which forces neurosurgeons to earliest possible surgical intervention on the spine and the spinal cord, was the almost regular development of different complications

(urinary tracts, pneumonia, bedsores, etc.) in the intermediate period of wound.

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However, one should consider that after the simultaneous mass admission of those wounded in the spine and obtained craniocerebral wounds which require urgent perfecting, and also with the restricted capacity of operating room it was necessary to differentiate indication of surgical intervention on the spine on the urgency.

Larger partly wounded the spine already during the day of admission into the specialized hospital underwent neuro-surgical and roentgenological examination/inspection, which more precisely formulated the diagnosis of wound and it made it possible tentatively to judge character/nature and degree of the damage of spine and spinal cord or horse tail.

In the given above classification of wounds and determinations of readings and contraindications to laminectomy with the bullet wounds of spine is contained the response/answer to a question about the periods of intervention. First of all in the absence of contraindications neurosurgeons' majority operated casualties with the blind-end and tangential penetrating wound of spine, especially

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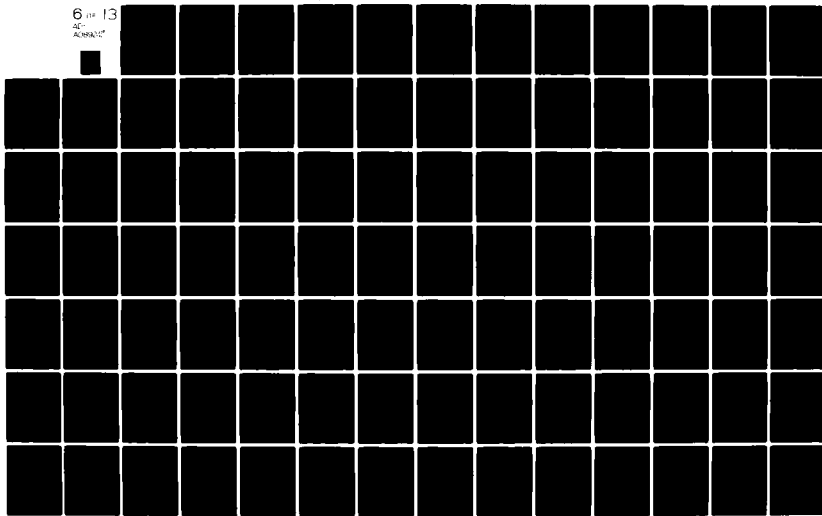
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with the syndrome of the partial violation of the conductivity of spinal cord, and in the second turn - casualties with the syndrome of the full/total/complete violation of the conductivity of spinal cord. In the third turn, but as far as possible early, they operated casualties with the perforating penetrating wound of the spine. As showed experiment/experience, especially importantly early surgical intervention when during the investigation were detected at least the minimum elements/cells of the conductivity of spinal cord. Delay with the operation/process, almost as a rule, it led on the 10-14th days to the full/total/complete violation of the conductivity of the spinal cord in connection with the progressive necrosis of the substance of spinal cord (M. P. Postolov, L. I. Smirnov et al.).

With all conditions it was considered that after laminectomy, especially early, "reduction processes in the spinal cord proceeded more rapidly, and secondary traumatic necroses were expressed weaker" (L. I. Smirnov).

Urgent laminectomies underwent usually wounded the spine, in which were detected: a) abundant liquorrhea, b) the difficulty of respiration as a result of edema or damage of the neck division of spinal cord, c) the appearance of initial signs of focus spinal meningitis (especially in the cases of the blind-end penetrating wound of the spine when necessary to urgently remove the source of

infection), of d) heavy pains with penetrating wounds (stimulation of rootlets and shells of spinal cord by foreign body or by bone fragments), e) secondary or repeated hemorrhages.

For conducting early surgical interventions on the spine is necessary the early delivery/procurement of casualties in the specialized agencies with the possible contraction/abbreviation of the stages of evacuation. During the more complex combat circumstances, the rapid advance of the troops/forces and the elongation of communications a quantity of stages of evacuation sometimes grew/rose to 6-8.

The delay of the admission of casualties into the spine into the specialized agencies led to the fact that the complications, which appeared up to the moment/torque of admission, frequently impeded timely radical intervention.

The relationship/ratio of the periods of laminectomy, produced in different stages of evacuation, evidently from Table 18.

Thus, if in the specialized hospitals of GBF the large part of laminectomies are done during the periods up to 1 month, then under conditions of PPG (GBA) two thirds of operations/processes they are produced into the first 10 days, i.e., to the onset of different

complications.

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Operability and characteristic of the operated casualties.

Under conditions of the military medical service of Soviet Army, depending on the series/number of conditions, the operability of those wounded the spine oscillated at different fronts and in the different time from 20.0 to 60.0o/o. This oscillation/vibration depended not so much on difference in separate neurosurgeons' views, as from sanitary-tactical circumstances at different fronts in the different time, or from connected with this periods of the admission of those wounded the spine into the specialized agencies. There is also no doubt the fact that the oscillations/vibrations of the numerals of operability were explained not only by the selection of the composition of casualties, but also by the character/nature of the operational intervention. One of the operations/processes in those wounded to the spine carried only interventions of the type of laminectomy, others was included in this number dissection of wound with the removal/distance of foreign bodies, bone fragments from paravertebral divisions, intervention apropos of osteomyelitis and so forth, etc.

According to the materials of the development of the history of disease/sickness/illness/malady, the primary radical treatment of wounded the spine with the removal/distance of bone fragments, foreign bodies and the revision of the contained spinal canal via laminectomy was produced into 21.90/o of cases. The absolute majority of similar interventions was produced in the therapeutic institutions of army and front line area. These data barely diverge from the data of separate fronts or armies. Thus, according to S. I. Banaytis's data, general/common/total operability, if we have in mind laminectomy, in the specialized separations/sections of front line hospitals comprised with the bullet wounds of spine and spinal cord 19.0-20.0o/o. Similar numerals obtained other neurosurgeons: D. Ya. Varshavskaya - 20.0o/o. V. A. Nikol'skiy - 22.2o/o, A. A. Shlykov - 19.3-19.8o/o. In the neuro-surgical center of Leningrad Front the operability (laminectomy) also composed 19.0o/o, and with the penetrating wounds of spine - 31.6o/o. In the opinion of the authors, who worked in the army area (V. A. Nikol'skiy), early laminectomy it required to 20.0o/o of casualties. With the penetrating wounds of spine the percentage of operability, it is doubtless, was raised; so, Ya. G. Rubenstein (1943) operated 58.7o/o of those wounded the spine, N. I. Grashchenkov (1946) reported 30.0o/o of those operated.



Table 18. Distribution of laminectomies according to the periods of intervention in the hospitals of GBA and GBP (in the percentages).

(2) Стан эвакуации	(1) Сроки оперативного вмешательства (после ранения)					(8) Итого
	(3) до 1 суток	(4) до 3 дней	(5) до 10 дней	(6) до 1 месяца	(7) свыше 1 месяца	
ГБА (ХННГ)	6,5	23,9	34,8	23,9	10,9	100,0
(9) Госпитали ГБФ	0,0	7,0	14,0	60,4	18,6	100,0

Key: (1). Periods of surgical intervention (after wound). (2). Stage of evacuation. (3) to 24 hrs. (4) to 3 days. (5) to 10 days. (6) to 1 month. (7) More than 1 month. (8). Altogether. (9). Hospitals GBP.

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Changes in the volume of operational activity with the bullet wounds of spine and spinal cord in many respects depended on the series/number of conditions. Thus, in the period of the blockade of Leningrad, taking into account the special difficulties of work in the besieged city, neurosurgeons adhered to that view, that into the early periods operated should be only with the penetrating into the spinal canal wounds without the full/total/complete violation of the conductivity of spinal cord. Therefore operated the predominantly blind-end and tangential penetrating wounds (to 90.00/o of all operations/processes) during the partial violation of conductivity or compression of spinal cord or horse tail. Only in a small number of

cases operated the perforating penetrating, and also nonpenetrating and paravertebral wounds. Cite data below of the neuro-surgical center of Leningrad Front about the operability depending on the character/nature of wound.

(1) Характер ранения	(2) Процент оперированных
(3) Сквозные проникающие . . . . .	11,5
(4) Слепые . . . . .	45,4
(5) Касательные . . . . .	28,2
(6) Непроникающие . . . . .	3,0
(7) Паравертебральные . . . . .	1,8

Key: (1). Character/nature of wound. (2). Percentage of those operated. (3). Through penetrating. (4). Blind penetrating. (5). Tangential penetrating. (6). Nonpenetrating. (7). Paravertebral.

Hence it is apparent that in essence laminectomy it was applied with the blind-end and tangential penetrating wounds. A small number of operations/processes with the perforating penetrating wounds of spine was produced with the wound at the level of horse tail. The detailed distribution of those operated according to character/nature and level of wound is given in Table 19, moreover the total number of those operated is accepted as 100.

From Table 19 it is evident that about quarter of all operations/processes were produced with the tangential penetrating wounds of the neck division of the spine where in view of special anatomical relations most frequently was encountered this means of

wound and associating it compression of spinal cord. 6.40/o of operations/processes fell on the nonpenetrating and paravertebral wounds. Laminectomy with the perforating penetrating wounds of spine it was conducted most frequently at the level of horse tail and with the wound by fine/small fragments at the level of the thoracic division of spinal cord.

Table 19. Distribution of those operated according to level and character/nature of wound (based on materials of the neuro-surgical center of Leningrad Front) (in the percentages).

(6) Уровень ранения поз. столбика	(1) Характер ранения	(2) Проникающие			(3) Непрони- кающие	(4) Параверте- бральные	(5) Итого
		(7) сквозные	(8) слепые	(9) касатель- ные			
(10) Шейный отдел (C <sub>I</sub> —C <sub>VII</sub> ) . . . . .		—	3,5	22,5	—	0,6	26,5
(11) Грудной и верхне- поясничный отдел D <sub>I</sub> —L <sub>II</sub> . . . . .		2,3	17,9	14,5	2,3	—	37,0
(12) Нижне-поясничный отдел (L <sub>III</sub> —L <sub>V</sub> ) . . . . .		2,9	19,0	9,8	2,3	0,6	34,6
(13) Крестцовый отдел (S <sub>I</sub> —S <sub>V</sub> ) . . . . .		0,6	—	0,6	0,6	—	1,8
(14) Всего . . . . .		5,8	40,4	47,4	5,2	1,2	100,0

Key: (1). Character/nature of wound. (2). Penetrating. (3). Nonpenetrating. (4). Paravertebral. (5). Altogether. (6). Level of wound of spine. (7) through. (8) blind. (9) tangents. (10). Neck division. (11). Thoracic and upper-lumbar division. (12). Lower-lumbar division. (13). Sacral division. (14). In all.

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The second in the frequency place occupied operations/processes apropos of the blind-end penetrating wounds of spine. With the paravertebral wounds laminectomy it was conducted only in the case of the doubt of the correctness of the determination of the

character/nature of wound against the background of heavy neurologic violations (pain, progressive difficulty of respiration).

Of all casualties with the clinical manifestations of the partial violation of the conductivity of spinal cord and rootlets of horse tail it underwent laminectomy 29.00/o.

Operations/processes during the expressed full/total/complete violation of the conductivity of brain were undertaken in the exceptional cases. With traumatic radiculites (or meningo-radiculites), which were being observed predominantly with the wounds of the neck or lumbar division of spine, sometimes with the foreign body near the rootlets of spinal cord or in the zone of the intervertebral aperture, are operated about 5.00/o of casualties (Table 20). Prognosis in the remaining similar cases remained favorable and during the conservative treatment. The given percentage of operability in the institutions of Leningrad Front must be recognized insufficient to high ones.

This was explained by the fact that alimentary dystrophia and avitaminosis observed in casualties, especially during the first year of war, they unconditionally impeded the wide conducting of surgical treatment. Nevertheless, as showed clinical experiment/experience, and also a careful study of data of autopsies, a number of

casualties, who were needing early laminectomy, could be increased not more than to 5.0-8.0o/o.

An increase of the number of those operated in the Great Patriotic War distinctly showed the value of the specialized neuro-surgical aid, and also a noticeable improvement in the neurologic and roentgenological diagnosis.

Within the late periods of those wounded the spine they operated in the neuro-surgical institutions of the deep rear from the appropriate readings. As showed experiment/experience, even late interventions in the appropriate cases proved to be effective (Z. I. Geymanovich, A. L. Polenov, S. I. Zdrilyuk et al.).

Table 20. Operability depending on the neurologic violations (based on materials of the neuro-surgical center of Leningrad Front).

(1) Неврологический синдром	(2) Всего раненных в позвоночник	(3) Из них оперировано	(4) Процент
(5) Синдром полного нарушения проводимости спинного мозга	387	4	1,0
(6) Синдром частичного нарушения проводимости спинного мозга	569	154	27,1
(7) Синдром полного нарушения проводимости корешков конского хвоста и конуса спинного мозга	84	6	7,1
(8) Синдром частичного нарушения проводимости корешков конского хвоста	481	150	31,2
(9) Травматический радикулит	84	4	4,8
(10) Повреждение позвоночника без неврологических нарушений	69	—	—
(11) Всего	1674	318	19,0

Key: (1). Neurologic syndrome. (2). In all wounded spine. (3). From them it is operated. (4). Percentage. (5). Syndrome of full/total/complete violation of conductivity of spinal cord. (6). Syndrome of partial violation of conductivity of spinal cord. (7). Syndrome of full/total/complete violation of conductivity of rootlets of horse tail and cone of spinal cord. (8). Syndrome of partial violation of conductivity of rootlets of horse tail. (9). Traumatic radiculitis. (10). Damage of spine without neurologic violations. (11). In all.

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Laminectomy technique with the bullet wounds of spine.

Special features/peculiarities of laminectomy. Laminectomy with the bullet wounds of spine on the whole it is similar to the same with the operations/processes of peacetime. However, it was nevertheless characterized by some special features/peculiarities, caused in essence: 1) by the presence of wound or wound canal in the zone of operating field and 2) by the presence of foreign body with the blind-end wounds.

It is virtually important that wound itself as well as wound canal, especially foreign bodies, they proved to be infected.

Infected wound insulated by special bandage with the aid of the cleol, the collodion, the adhesive mat/patch or via the stitching of linen to the skin around the operating field.

With surgical intervention in the early periods the wound, which



was being arranged/located along the center line or near from it, underwent usual primary surgical perfecting. Access to the spine in these cases was realized through the wound. In the operations/processes within the later periods and the presence of the infected wound the latter underwent late primary or reworking from the readings, and access and to spine as far as possible was realized beside the wound.

Bedsore, if they were located near from the predicted operating field, treated and insulated just as the infected wounds. In the presence of foreign body, especially in the spinal canal, before the operation/process directly produced the supplementary X-ray analysis of spine with any contrast metallic sign on the skin at the level the localizations of foreign body (Fig. 73). Latter/last measure was necessary because: 1) sometimes foreign body up to the moment/torque of operation/process was moved along the spinal canal up to considerable distance (A. G. Stolz et al.), 2) the determination of a precise level of laminectomy presents sometimes considerable difficulties even for the experienced neurosurgeon.

Taking into account the specific special features/peculiarities surgical of interventions technique on spine and contents of spinal canal, is given below the description of technology separately for the basic stages of surgical intervention.

Anesthetization. In the Great Patriotic War most frequently with laminectomy was applied local infiltration anesthesia.

Due to the onset of pains there were encountered difficulties with the removal/distance of foreign bodies and bone fragments from the dural sack, especially incorporated in the spinal cord or the rootlets of horse tail or arranged/located in the forechamber of dural sack. In similar cases was necessary supplementary anesthesia.

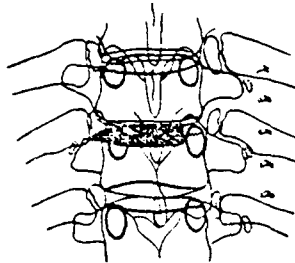


Fig. 73. Metallic signs on the skin (Michel's bracket), which confirm the level of localization of foreign body in the spine.

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For this purpose the surgeons anesthetized the morbid sectors of the shells of spinal cord and rootlets, applying to them for 3-5 minutes the wadded ball/sphere, moistened by 50/o solution of novocaine, or introducing 1-2 cm<sup>3</sup> 20/o solution of novocaine into the zone of each previous rootlets and sub-arachnoidally at the level of surgical intervention. Usually this it proved to be sufficiently for conducting the operation/process. In the rare cases it was necessary to resort to the supplementary inhalation ether/ester or intravenous hexobarbital anesthesia.

Operation/process on the neck division of spine performed, as a rule, under the local anesthesia to avoid risky preanesthesia

excitation and possible at this time displacement of bone fragments, what is risky for the life of casualty.

Based on materials of the neuro-surgical center of Leningrad Front, under the local anesthesia it is carried out to 62.00/o of laminectomy, under mixed anesthesia/narcosis (novocaine + hexenal or + ether/ester) -20.00/o and under inhalation ether/ester anesthesia -18.00/o. No complications, connected with the use/application of hexenal in the combination with the novocaine, it was noted. A. N. Bakulev produced under local anesthesia 90.50/o of operations/processes.

Local anesthetization technique was usual. After the preparation of operating field, to the facing by its linen, if it was not bullet wound or wound scar in the zone of operating field, usually were deposited supplementary markers to the skin at the level of the predicted pathological focus. For this to the greased by iodine skin was applied marker by 100/o silver nitrate or produced the surface incision of skin with scalpel.

For the infiltration anesthesia surgeons' majority put to use 0.5 or 0.250/o solution of novocaine (usually 250-300 cm<sup>3</sup>). They first infiltrated skin for entire elongation/extent of the predicted section/cut (not less than 5-4 vertebrae), then with long

needle-periosteum of the small arcs of the vertebrae, which are subject to laminectomy, moreover from each side from the awned extension into the side of the root of handle was introduced on 10-15 cm<sup>3</sup> of solution; finally, they infiltrated with novocaine the adjacent longitudinal muscles of back.

Section/cut of skin. Exposure and slicing of the awned extensions and friends. The section/cut of skin neurosurgeons' majority produced along the line of awned extensions. Only with the contaminated wound of considerable sizes/dimensions, which was being arranged/located along the center line, produced the curved section/cut skins, which borders wound at a distance of 5-6 cm from it (Fig. 74). The wound of small width, independent of depth, incidentally they cut all over. Made two parallel sections/cuts along both sides of the heads of awned extensions in place the fastenings of muscles and carefully with the aid of wide raspatory or wide chisel muscles together with the periosteum separated from the awned extensions and the small arcs to the line of joints from both sides. Appearing in this case hemorrhage from the muscles easily stopped by tamponade by the moistened in the hot physiological solution gauze towels (Fig. 75). After careful skeletonization of awned extensions and posterior divisions of small arcs the latter bit different by forceps (Fig. 76).

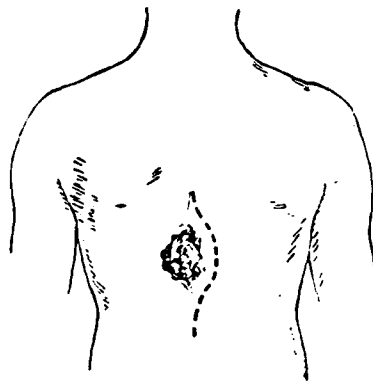


Fig. 74. Section/cut of skin with laminectomy.

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With the wounds of the posterior sawing of vertebrae usually proved to be damaged awned extensions, small arcs and yellow ligament. To removal/distance it was subject, almost as a rule, not less than 3 small arcs of vertebrae, i.e., except the damaged vertebra (vertebrae), additionally bit awned extensions and small arcs above- and the underlying vertebra. However, the limitation of laminectomy only by the damaged vertebrae narrowed operating field, it made the alignment by that acted unsure and very impeded taking the necessary measures on the contents of spinal canal.

When there were free fragments of small arcs, displaced into the

spinal canal or in other direction, with the removal/distance of the latter immediately was opened/disclosed the access into the spinal canal.

With slicing of the posterior divisions of small arcs in upper-thoracic division of spine it fit as far as possible to be limited to the medial line of intervertebral joints (Fig. 77) to avoid probable in this case aeroembolism as a result of the suction of the air through the damaged gaping intervertebral veins (A. L. Polenov, Ye. P. Nikul'chenko).

Exposure and slicing of awned extensions and small arcs began from the healthy/sound divisions (from the caudal edge of wound), continuing towards the damaged vertebrae. Special care it was necessary to exhibit with exposure and slicing of damaged handles, since even insignificant pressure to the mobile/motile fragments of the broken small arc could prove to be disastrous for the subjects of the sectors of spinal cord. In this respect with the maximum care was conducted slicing of the damaged small arcs in the neck division of the spine where the latter greatly closely fit closely to the solid cerebral shell.

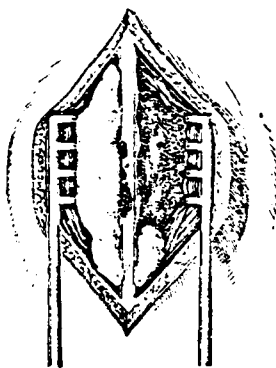


Fig. 75.

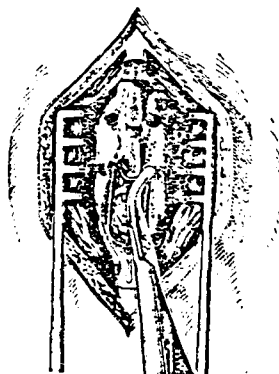


Fig. 76.

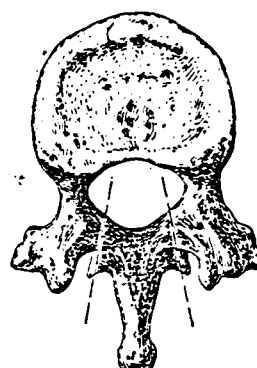


Fig. 77.

Fig. 75. Skeletonization of awned extensions and small arcs. To the left-cessation of hemorrhage by tamponade.

Fig. 76. Exposed awned extensions and small arcs are sliced.

Fig. 77. Scheme of boundaries of laminectomy.

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In the presence of foreign body in the spinal canal, especially during its disposition in the posterior divisions of the spinal canal (it is epidural or it is subdural), any pressure by the cheeks of cutting pliers can additionally traumatize spinal cord. Therefore with the blind-end penetrating wounds of spine for slicing of small



arcs at the level localizations of foreign body put to use Janssen's forceps with the thin cheeks, observing in this case maximum care.

The form/species of the adjacent epidural cellulose frequently determined upper and lower boundary of laminectomy. At the level of trauma (and of subdural changes) fatty epidural cellulose during the first days after wound was frequently impregnated with the blood, was softened and traumatized, but after 7-10 days it was by already atrophic, sclerosed, and later, depending on the period, which passed after wound, even Rubtsov regenerated. Frequently at the level of equalization cellulose completely was absent or was replaced by individual Rubtsovs by cross connections, in the late period usually leading to the cicatricial compression and the strangulation of dural sack.

The appearance of fatty cellulose of normal mode in the upper and lower angle of epidural space usually attested to the fact that laminectomy was carried out on the boundary of pathological changes (roughly morphological) in the contained spinal canal.

Thus, the small arcs of vertebrae were driven out before the appearance of normal fatty cellulose in the upper and lower division of wound. After the removal/distance of hematoma (with the operation/process during the first days after wound) the

remainders/residues of fatty cellulose dully divided. Insignificant hemorrhage from the veins of cellulose easily stopped by pressing by gauze towel. In the rare cases it was necessary to resort to tamponade of the bleeding sector the small piece of muscle.

Normal solid cerebral shell appears dull, with the slightly bluish hue, it is moderately strained and fluctuates synchronously to respiration and to heart contractions (Fig. 78).

With the wounds of spine and spinal cord solid cerebral shell frequently had a series/number of deep changes. It lost its color and became slightly dull or it appeared pinkish, hyperemized. Dural sack lost its usual form; as a result of the compression by the fragments or by the issuing from blood disappeared its pulsation. In the fresh cases in the cerebral shell were detected sometimes the gaps, through which ensued/escaped/flowed out the cerebro-spinal fluid, mixed with the blood, or cerebral detritus.

Within the later periods to these changes were connected the growths of granulating tissue or cicatrical connective tissue, depending on the phase of wound process.

With the inspection of epidural space it was possible in the appropriate cases to reveal/detect bone fragments and foreign bodies, and also slits and defects in the solid cerebral shell during its damage.

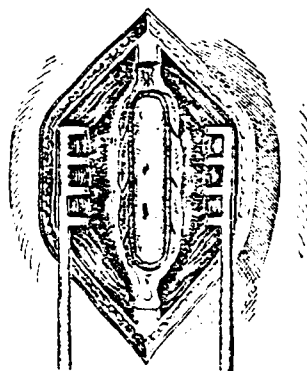


Fig. 78. It is produced laminectomy; is exposed solid cerebral shell.

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This careful inspection of solid cerebral shell and epidural space made it possible to frequently solve problem from the need for the autopsy of solid cerebral shell or failure of this measure. In the absence of readings to the autopsy of solid cerebral shell the operation/process was usually limited to the production of meningoradicolysis. The essence of this operation/process was reduced to the release of solid cerebral shell and rootlets from the compression by foreign body, bone fragments, hematoma, by Rubtsovs by intergrowth, etc. During the removal/distance Rubtsov, that compress dural sack, in the absolute majority of the cases it was possible to preserve the completeness of solid cerebral shell. During the study

of the histories of the disease/sickness/illness/malady of different hospitals are encountered the indications of removal/distance sometimes Rubtsov together with the external leaflet of solid cerebral shell without the autopsy of internal leaflet. With the operations/processes within the early periods after wound loose intergrowth usually were removed dully, with the aid of the narrow cerebral spatula; with the operations/processes within the late periods, almost as a rule, with the aid of the scalpel. After careful meningolysis usually appeared the seen with eye pulsation of dural sack, synchronous to pulse and to respiration.

A question about the autopsy of solid cerebral shell was not solved dogmatically for all cases; therefore surgeons' views in this respect frequently diverged. The unit of the surgeons (V. A. Nikol'skiy, B. A. Rogal'skiy, Z. I. Gymanovich, I. S. Babchin et al.) recommended to abstain from the autopsy of solid cerebral shell, if it was not damaged, being careful of the penetration of infection. V. A. Nikol'skiy (1943) assumed that the solid cerebral shell should not be revealed, even if under it was determined hematoma. A. N. Bakulev, A. V. Bondarchuk et al. recommended the revealing of solid cerebral shell in all cases for the inspection of under-shell space and spinal cord, without fearing infection and assuming that the above-shell changes do not reflect the character/nature of changes in the spinal cord.

If in the dural sack we feel or according to roentgenological data was determined foreign body, and inlet in the solid cerebral shell could not be revealed/detected or it was too little for the removal/distance of the foreign body and bone fragments, then solid cerebral shell, as a rule, they revealed.

The autopsy technique of solid cerebral shell. Solid cerebral shell they notched by scalpel along the center line, enveloping the vessels, which sometimes spread over its posterior surface. Into this cut was introduced the U-shaped probe on which they cut solid cerebral shell on entire extent, without reaching on 1-1.5 cm the preserved small arcs in the cranial and caudal division of wound for convenience in the subsequent stitching on it (Fig. 79).

In the presence of the damage of solid cerebral shell over the posterior surface its dissection was conducted, beginning from the sector of damage. On the edge of solid cerebral shell laid provisory sutures by thin silk or tender terminals bred them to the sides, which gave the possibility to inspect contents of dural sack.

Removal/distance of foreign bodies and bone fragments. The removal/distance of foreign bone fragments presented to different

degree of difficulty depending on their localization.

During the searches/scannings of foreign body the investigation usually is begun from the inspection of under-shell space on the posterior, the lateral, and if it is necessary, then over the front face of spinal cord.

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For this spinal cord they carefully displaced to the side by tender cerebral spatula or by light rotation of spinal cord for the odontoid ligament, seized by terminal and crossed towards the outside from the terminal. In the rare cases for this purpose it was necessary to sacrifice some rootlets (preliminarily blocking it by 2o/o novocaine). If with this inspection of under-shell space for entire elongation/extent of the exposed sector of spinal cord they did not detect foreign body and bone fragments, then usually nevertheless it was possible to reveal/detect them in the substance of spinal cord by the light touch palpation of spinal cord. If (in the exceptional cases) foreign body could not reveal/detect thus, then produced repeated X-ray analysis on the operating table for the exclusion the possibilities of the error in the determination of the level of its localization. The prolonged searches/scannings of fine/small foreign bodies are unsuitable, since the insignificant damages,

plotted/applied to spinal cord by this foreign body, could be only increased by the excessive manipulations of surgeon. More or less considerable sizes/dimensions foreign bodies, as a rule, were determined without the special work.

Difficulties appeared also during the removal/distance of the foreign bodies, which were being arranged/located on the front face of dural sack, especially if foreign body was introduced in the body of vertebra. In this case the access to the foreign body in the presence of readings to its removal/distance can be chosen extradurally or transdurally (Fig. 80).

With the small foreign bodies and the bone fragments, available for the removal/distance, the latter were driven out through the sectors where they were located nearest of all to the surface of spinal cord (Fig. 81). With the occurrence of large/coarse foreign bodies in full or in part in their spinal cord they drove out on the course of wound canal, as if following by back stroke the path of the wounding shell, which is evident from the following description.

Wounded I., 43 years, 9/III 1944 was obtained the blind-end bullet penetrating wound of spine at the level of the VII thoracic vertebra with the partial violation of the conductivity of spinal cord at the level of the tenth thoracic segment. Up to the

moment/torque of admission into the specialized hospital (GBP) was determined the paraplegia of lower extremities with a sharp increase in deep reflexes into them and fallout of all forms/species of sensitivity to the left from the tenth thoracic segment from the lungs by illumination in lower-sacral segments; to the right deep hypesthesia in the limits of the same segments. Delay of the function of pelvic organs/controls.

In the X-ray photographs was determined gun bullet, partly (by spout) arranged/located in the spinal canal, partly (by heel) - in the right intervertebral aperture of the VII and VIII thoracic vertebra.

30/III 1944 with laminectomy is discovered the defect of solid cerebral shell to the right with small liquorrhea. Through this defect bullet derived could not be. After supplementary slicing of the right joint of the VII and VIII thoracic vertebra bullet was possible to derive along the wound canal to the side of pleura and to move away. The post-operation course of wound smooth, functional fallouts after operation/process was not added. Through 3 years it walks with the aid of the crutches; pains in the lower extremities disappeared. The function of pelvic organs/controls was reduced. Was recovered sex function.



With the operation/process in the intermediate and late period the foreign bodies were usually represented by those imbedded into the capsules. Some authors recommended the driving out of them together with the capsule.

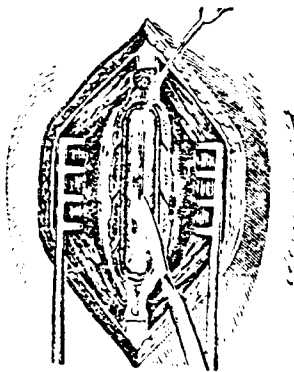


Fig. 79. Autopsy of solid cerebral shell on the U-shaped probe.



Fig. 80. Removal/distance of bullet from the forechamber of dural sack. Capsule is split, bullet carefully is ejected into the wound. Observation S. I. Zdrilyuka. (Khudozhnik T. V. Belyayev).

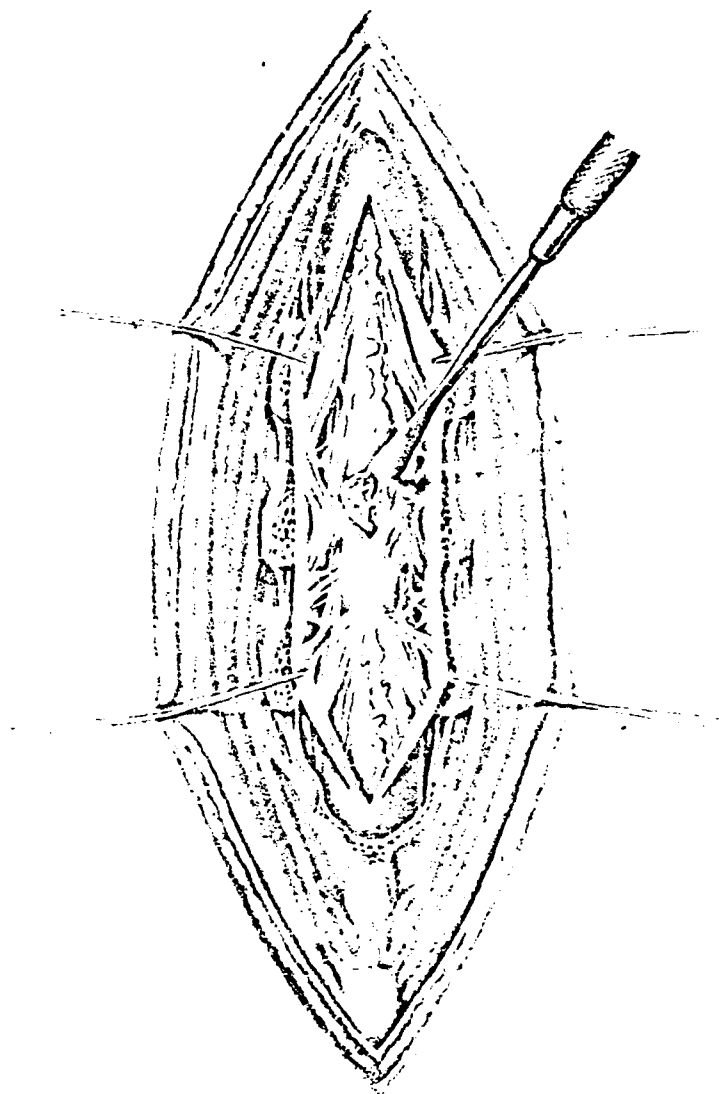


Fig. 81. Removal/distance of bone fragment from the substance of spinal cord. Observation of S. I. Zdrilyuk. (Artist T. V. Belyayeva).

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However, in a number of cases the carving of capsule was represented by matter to difficult and traumatic ones. Similar cases surgeons' majority usually rejected the carving of capsule by rear sight, being limited to its dissection or only partial carving. It is doubtless, in this case grew/rose the danger of the outbreak of latent infection, nevertheless this risk under the contemporary conditions (antiseptic, antibiotics) could be considered justified.

Thus, according to data of one of the specialized hospitals of front, to 60 operations/processes of the removal/distance of foreign body from the spinal cord or from the region of rootlets of horse tail (with the blind-end penetrating wounds of spine) in 6 wounded post-operation period it was complicated by meningitis (in 4 cases of focus and in 2 cases diffuse cerebrospinal form), moreover only in one case meningitis proved to be the reason for death.

During the removal/distance of the foreign bodies, which were delayed among the rootlets of horse tail, it is necessary to spare rootlets not only for the purpose of the retention/preservation/maintaining their conductivity, but also to avoid post-operation pains. Frequently achieving this goal helped the preliminary infiltration of tissue around the scar by novocaine.

During the removal/distance of foreign body (with the capsule or without it) to its gunstock slightly they rubbed by the small gauze ball, moistened by peroxide of hydrogen.

From the dusting by sulfanilamides of the bed of foreign body after its removal/distance some surgeons abstained to avoid possible secondary hemorrhage (A. N. Bakulev, N. I. Grashchenkov), also, in view of certain toxicity of sulfanilamides during the direct application of preparation to the spinal cord.

Suture of rootlets. In the cases of the gap of rootlets of horse tail is theoretically justified stitching on the damaged rootlets (N. M. Burdenko). In this case they always attempted to, first of all, lace the central and peripheral cuts of motor rootlets, at least and the noncorresponding segments. In connection with the absence of epineural shell the suture is produced through the thickness of the refreshed rootlets. For this was applied thin, round needle with the appropriate silk or catgut No 0-00. By one suture of the cutting off of rootlets they drew together to the light contact or even with diastasis between them in 1-2 mm. With the least tension the rootlets were defiberized to the separate barrels.

In the Great Patriotic War it was not communicated about the cases of the suture of spinal cord, since this operation was aimless. In this respect the separate observations of the old authors (I. I. Grekov, A. P. Finikov, Hart, etc.) are of only historical interest.

Sewing of solid cerebral shell. After all necessary manipulations in the sub-cerebral space and on the spinal cord are produced, it is necessary to reduce the completeness of solid cerebral shell. On the place of its section/cut thoroughly were laid frequent continuous or knotty silk sutures. Special attention was focused on the careful occlusion of solid cerebral shell in the angles wound- places where it is more frequently, in all are formed liquor fistulas (Fig. 82).

The small tissue defects in the solid cerebral shell, sometimes arranged/located beside the operating section/cut, especially with the wounds at the level of horse tail, reduced by stitching. The more or less considerable defects of solid cerebral shell presented considerable difficulties for their occlusion. In these cases frequently it was necessary to resort to the plastic receptions/procedures.

Plastic of solid cerebral shell. Extremely important was a question about the substitution of the defects of solid cerebral shell in the appropriate cases. Narrow wound slits or slit-shaped defects in the solid cerebral shell took in, without refreshing its edges, without the risk of the compression of spinal cord. More or less considerable defects in the solid cerebral shell were plastically occluded with the free graft/flap of the fascia, undertaken hereabout in the zone of operating wound (fascia superficialis). In this case the edge of defect in the solid cerebral shell they did not refresh as much as they equalized, driving out fringed patches/grafts/flaps. Fascia in such cases they hemmed to the solid cerebral shell by several knotty silk sutures. If defect in the solid cerebral shell was arranged/located along its lateral surface, it occluded with the flat/plane free graft/flap muscles, obtained also in the operating wound (long muscles of back). The plastic of solid cerebral shell it prevented liquorrhea.

The casualty III obtained the tangential bullet penetrating wound of spine at the level of the V lumbar and 1 sacral vertebra. With the operation/process through 2 weeks is discovered the saddle-shaped strain of the dural sack, compressed by bone fragments; the defect of solid cerebral shell (4x1.5 cm) over the posterior surface was spread from the I sacral to the IV lumbar vertebra. Is produced the release of rootlets of horse tail from the intergrowth

and the plastic of solid cerebral shell by the free graft/flap of fascia, fixed/recorded by four silk sutures. In the post-operation period are noted the elements/cells of meningism, through the week which were smoothed. Operating wound healed by primary tension. Through 3 1/2 weeks it is evacuated into the deep rear. Clinically was noted the distinct clearing of sensitivity in the sacral segments.

The fine/small defects of solid cerebral shell, especially at the level of spinal cord, completely did not take in, but only covered by the graft/flap of muscle or the long muscles of back hermetically they took in by a double-row-triplostichous suture.

In the rare cases despite the fact that the solid cerebral shell was defense in the post-operation period, was observed insignificant and short-time liquorrhea, which did not cause any noticeable consequences.

From 4/IX 1944 were obtained the blind-end fragmentation penetrating wound of chest, the blind-end fragmentation penetrating wound of abdominal area with the damage to the liver and the nonpenetrating fragmentation penetrating wound of spine at the level of the XII thoracic vertebra with the partial violation of the conductivity of spinal cord at the level of the twelfth thoracic



segment. 4/IX, on the removal of casualty from the shock, on DMP it is produced thoracolaparotomy with the sewing up of the wound of the liver. In connection with the delay of urine is superimposed urinary bladder fistula. Through the week appeared light active movements in the left lower extremity.

22/IX with the X-ray analysis is discovered foreign body by the size/dimension 0.8x0.6x0.6 cm, that was being arranged/located in the center of spinal canal at the level of the XII thoracic vertebra. After wound - laminectomy. Removal/distance of small arcs from the XI thoracic to the I lumbar vertebra. Solid cerebral shell over the posterior surface is not damaged, but strained, cyanotic and did not fluctuate. Through the solid cerebral shell distinctly palpated the foreign body, which was being arranged/located in the substance of spinal cord, predominantly in its right half. After the autopsy of solid cerebral shell is produced longitudinal myelotomy through the right posterior column. Is removed foreign body. Anechoic sutures.

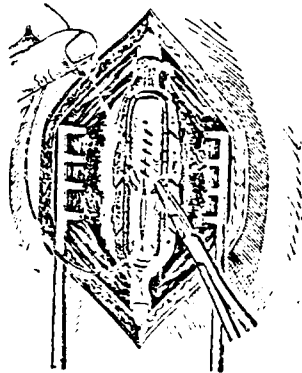


Fig. 32. The continuous weld to the solid cerebral shell.

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In the post-operation period insignificant liquorrhea during 6 days.

In 2 months were reduced active movements in the left lower extremity, appeared the weakened movements in the hip and knee joint of right lower extremity. Hypesthesia in the limits from the fifth lumbar and to the fourth sacral segment from both sides, moreover it is not discovered the redoubling of the violation of the musculoarticular feeling in the right lower extremity, in spite of the dissection of the posterior column of spinal cord to the right. Was reduced random urination.

Through 3 years walks with the aid of one crutch the function of pelvic organs/controls in the limits of norm.

The given observation is of interest not only from the point of view of the rapid liquidation of liquorrhea in the post-operation period, but also from the point of view of sequence and periods of intervention with the multiple and combined wounds, or sparing myelotomy technique for the extraction of foreign bodies from the substance of spinal cord.

With the operations/processes on the spine and the contents of spinal canal turned special attention to careful hemostasis for the purpose of prophylaxis of infection and late intergrowth between the shells. Operating wound after laminectomy almost all surgeons sewed, as a rule, in layers <sup>1</sup> tightly with the gauze or rubber graduates, introduced for 36-48 hours into the angles of wound.

FOOTNOTE <sup>1</sup>. Blanket suture with thin silk (No 0-00) to the solid cerebral shell; knotty sutures by durable catgut or by silk to the muscles and aponeurosis (it is separate) and by silk to the skin.  
ENDFOOTNOTE.

Graduates must be finished to the solid cerebral shell (Fig. 83).

In the cases of unclamped bullet wound, which was being disposed of paravertebrally and reached the spine, wound canal they usually scraped by sharp/acute spoon and into it introduced also gauze graduate with his gradual pulling with the dressings on the measure the cicatrizations of wound canal.

Under these conditions the individual authors (A. N. Bakulev, I. S. Babnin) obtained the healing of operating wound primary extent into 75.00/o surface festering of wound with the disagreement of separate sutures into 17.00/o and festering with the need of disclosing/expanding the wound into 8.00/o.

Sutures from the operating wound were driven out on the 10-12th day.

In the individual, doubtful in the sense the infections cases (in the hospitals of some fronts and in the number of civil/civilian therapeutic institutions) already on the 3-4th day operating wound exposed to to ultraviolet lighting in dose 100-200 UPYe. In these all cases, judging based on materials of reports, wounds healed by primary tension.

In the absence of paralyses in the lower extremities by patients was permitted to get up not earlier than 3 weeks after operation/process.

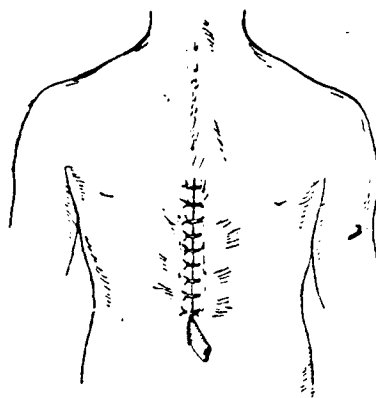


Fig. 83. Anechoic suture of wound with the rubber graduate.

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Special importance at all fronts was added to the early use/application of the therapeutic exercise after operation/process. A. N. Bakulev already from the first days after operation/process assigned passive movements as preventive substance against the development of bedsores. From the 3-5th day after operation/process the therapeutic exercise was reduced to the hygienic gymnastics and the exercises for the respiration, while from the 6-8th day were connected exercises for parathetic muscles of extremities. Through 2-3 weeks in the appropriate cases assigned the exercises for the muscles of abdominal press (with the wounds at the level of horse tail and lower-thoracic division of spinal cord).

Principles of stitching of post-operation wound.

~~Doctor of medical sciences professor V. A. Zhar.~~

The afterward final and radical working of the wound of spine and spinal cord or horse tail always arose question, to sew the bullet wound of spine tightly or to leave it opened.

The decision/solution of this question with the wounds of spine and spinal cord occurred to judgement of the operating surgeon. This, apparently and was the reason for those oscillations/vibrations which were observed during the decision/solution of a question about stitching of wound with the wounds of spine.

Contradictory opinions on this question met in the textbooks on the military field surgery, which left in the first half war. Thus, M. N. Akhutin (1942) wrote: "after the mechanical cleaning of wound she it is loosely fulfilled by the gauze, moistened in the antiseptic solution (chloramine, Rivanol)", and S. I. Banaytis in regard to this wrote: "in the aseptic cases solid cerebral shell they sewed by tightly thin silk. Muscular wound, if there are no contraindications, they sewed by catgut; silk suture to the skin".

The experiment/experience of the Great Patriotic War showed that in the decision/solution of a question about stitching tightly of wound after laminectomy it was necessary to be guided by the character/nature of the wounding weapon, by the time, which passed from the beginning of wound to the moment/torque of operation/process, and by the pathoanatomical changes, discovered in the wound during the primary perfecting.

In this case established/installed, that bullet wounds without extensive crushings of tissues actually could be considered noninfected, while wounds by the fragments of shells, especially min, they were always considered infected.

Therefore bullet wounds without the extensive damages/defeats of tissues after surgical perfecting it was possible to sew tightly, while fragmentation wounds in the presence of extensive damages presented considerable difficulties for stitching tightly.

In further experiment/experience of war was revealed the very important biological factor in the bullet wound, which changed installations. However thoroughly was treated wound after the bullet wound of spine, it was difficult to rely on its full/total/complete

sterilization. Even afterward, it would seem, full treatment of wound in it remain bacteria, necrotic tissues, hemorrhages, etc. But nevertheless in the processed wound the reduction processes prevail above the processes of decomposition/decay and in the wound occur the chemical and biological processes, which lead to the death of the remaining causative agents of infection and the cleansing of wound from the fission products. On the basis of the pathoanatomical investigations, produced during the Great Patriotic War, L. I. Smirnov indicated that after laminectomy, by especially early, the cleaning and reducing (organizational) processes in the wound occurred more rapidly than in the wounds of those not finished.

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Therefore neurosurgeons' majority in the absence of the sharply pronounced both overall and local phenomena even 12-14 days after wound performed surgical perfecting and they sewed wound tightly. Within the later periods when wound already cicatrized (15-45 days) and was conducted usual laminectomy, wound, as a rule, they also sewed tightly.

In the final stage of the operation, both in primary surgical treatment and in the later laminectomy, the most important moment is the sewing together of the meninx fibrosa. In this respect all neurosurgeons came rather quickly to the same



conclusion; in terminating treatment of the wound the opening in the mennix fibrosa should be sewn. If this is not possible, then the spinal column must be covered with a plate of mennix fibrosa or a fascial plate and the surrounding muscles then carefully sewn together. This has been confirmed by all experience gained in the Great Patriotic War.

The tendency to sew wounds tightly after laminectomy apropos of the bullet wound of spine and spinal cord undertaken from the observations of peacetime was conducted by individual surgeons even in the prewar period, and then during the Great Patriotic War.

One of those first systematically and consecutively/serially conducted stitching of wound tightly after laminectomy during the Great Patriotic War was A. N. Bakulev. It soon followed by V. V. Lebedenko, N. I. Grashchenkov, V. D. Golovanov, G. P. Kornianskiy, I. S. Babchin, A. S. Orlovskiy et al. Besides in addition to this, at many fronts there were the separate attempts at stitching of wounds tightly after laminectomy, as is evident from the separate histories of disease/sickness/illness/malady.

In the period of the Great Patriotic War, in view of the frequent cases of wound infection, osteomyelitis, anaerobic infection, became obvious a difference in the concepts "microbial contamination" ("microflora of wounds") and "wound infection." The predominant role of necrosis in the course of the wound process and its complications was revealed and the

value of the immunobiological properties of the organism during different periods of the wound process were established.

The experience gained from the Great Patriotic War showed that:

1. Wounding of the vertebral canal containing the spinal cord and its elements, just as wounds to the chest and abdominal cavities, required a hermetic covering to create the most favorable conditions for healing of the wound and prevention of infection.
2. Layer-by-layer sewing of the wound after laminectomy, according to modern surgical concepts, is only possible after careful and thorough excision of nonviable tissue, which serves as a substrate for the development of infection.
3. Wound in region of spine after laminectomy, being tamponed, healed long and slowly.
4. Healing in this case occurred via extensive and dense scar which could sharply strain dural sack.
5. Direct adjoining of tampon to dural sack under conditions of military circumstances is dangerous due to possibility of supplementary infection of solid cerebral shell and development of pachymeningitis.
6. Compression of tissues of wound with lowered/reduced trophic function by tampons increased boundaries of original necrosis and contributed to more rapid penetration of infection into shells of spinal cord and to development of meningitis.

All these data substantiated the need of applying anechoic suture after laminectomy under the condition for the sufficient removal/distance of necrotic tissues and approach of healthy/sound tissues via cross-linking above the spinal cord and its shells.

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Anechoic suture even during the partial festering of wound contributed: 1) to the more rapid healing of wound; 2) to the education of the tender scar, which deforms dural sack only to the insignificant degree or its even completely not changing; 3) to the prevention of the penetration of infection into the area of dural sack.

On the basis of these prerequisites/premises, the significant part of the neurosurgeons began to practice anechoic stitching of wound both during the primary surgical perfecting (early) and with later surgical interventions.

So, A. S. Orul to 40 early (on 1-14th day) surgical perfecting of the wounds of spine and spinal cord produced stitching of wound tightly in 34 casualties. 6 Wounded this had impossibility in view of

the considerable defect of skin after wound. Of 6 cases of the festering when it was necessary to dissolve sutures, in 4 cases the healing subsequently occurred without the special complications.

On 40 surgical interventions the fatal result advanced in 8 casualties. The reasons for death: meningitis in 2 cases, combined wound of the lungs - into 2, shock - in one, cachexia - in one meningomyelitis - in 2 cases.

After 14 late laminectomy (on 15-45th day) the fatal result advanced in 4 casualties. Reasons for death: meningitis - in 2 cases, sepsis - in one and urosepsis - also in one case.

From the preceding information it is evident that to avoid the outbreak of infection with the late operations/processes is not always possible.

According to A. N. Bakulev's data, in the rear hospital the large part of the heavily wounded (51.30/o) with the septic condition, the extensive bedsores, the full/total/complete damage of the functions of pelvic organs/controls and the violations from the side of nervous system into 55.50/o was operated radically, of them into 49.30/o of cases was superimposed anechoic suture.

On the periods of surgical intervention the studied contingent of casualties also presented some special features/peculiarities. Thus, the large part of the casualties was operated in time after 30 days. The required volume of operational aid was conducted within any periods, but its character/nature considerably was changed depending on presence or absence of infectious complications.

As very large help in the understanding of wound process and, consequently, also the selection of the best periods of the imposition of anechoic suture after laminectomy can serve the immunobiologic phenomena, which occur in the wound.

Finally, by the decisive moment/torque during the imposition of anechoic suture was operational access to the place of main damage/defeat - to focus of destruction. The granulating wound is considerable contraindication. However, in the period of the Great Patriotic War this opinion was considerably shaken.

From given in Table 21 data it is evident that more than in the half all cases the operating access passed through the wound, it is doubtless to a certain degree one infected and containing or the other microflora. During the investigation of microflora of the wounds, through which was conducted the operation/process, were discovered, together with different forms/species of staphylococci

and streptococci, the rotting microbes, from which in the first place in the frequency stood the Proteus, the coliform bacterium, are thinner/less frequent pyocyanic, etc.

In the beginning of the Great Patriotic War the presence of rotting flora in wound discharge considered contraindication to surgical intervention the imposition of anechoic suture, but subsequently surgical intervention was conducted also on the wounds, which contain Proteus, but under the necessary conditions of an improvement in the general condition of wound and noticeable shift/shear in the direction of its cleansing.

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Thus, with the operation/process through the bullet wound operating wound was sew tightly into 64.0o/o of all cases and did not sew itself into 36.0o/o. From the sew tightly wounds it healed by primary tension 44.0o/o and secondary - 56.0o/o. During the operation through the scars was obtained the festering only in one case, in the remaining occurred the healing of wound by primary tension.

It should be noted that even during the operation through the healthy/sound tissues in the unit of the cases nevertheless was developed the festering. Thus, in those survived during the operation

through the healthy/sound tissues the healing of wound by primary tension occurred into 81.00/o of cases, and in dead persons - into 45.00/o of cases.

Consequently, and in these cases the general condition of organism plays the leading role in the healing of post-operation wound.

Anechoic suture in the majority of the cases was laid in view of the tendency to close the wound on day of which was located the solid cerebral shell, exposed from its covering fatty layer, sometimes even with the superimposed to it suture. The tendency to cover this sector served as basis to stitching of wound tightly. This surgical intervention was dictated by the degree of the dissemination of necrosis in the wound and, consequently, also by the degree of the reproduction/multiplication of microflora in it.

For the imposition of anechoic suture the available wound must be subjected (primary or secondary - depending on periods) to the surgical perfecting which has as a goal, first of all, carving not only on the surface, but also in the depth, examination/inspection and disclosure/expansion of all scalings and pockets, mechanical cleaning, full/total/complete hemostasis and removal/distance of all foreign bodies both wounded (bullet, fragment), and carried into the

wound (clothing, tree/wood, etc.).

All these conditions, incorrectly taken into consideration by different authors, and were the reason for that mismatch in the responses/answers to questions in a form, sent out to the prominent neurosurgeons of our country. Together with the ardent enemies, are enthusiastic followers, and calm contemplators, who voice their point of view on the basis not of skills, but logical conclusions. "The anechoic suture of the processed bullet wound of spine I consider counter-indicative, - writes A. Yu. Sozon-Yaroshevi, he saw heaviest festarings even during the narrowing by the sutures of the unit of the wound despite the fact that the wound was treated personally and sign technician of its processing".

"As mass measure anechoic suture during the primary perfecting is contrasted. It is feasible sometimes of the lighter wounds, processed during the first days after wound, during the use/application of antiseptics and antibiotics, under the condition of the post-operation steadying of casualty", writes Z. I. Gaymanovich.



Table 21. Direction of operating access with laminectomy (in the percentages)

(1) Операционный доступ	(2) Оперированные	
	(3) выжившие	(4) умершие
(5) Через рану . . . . .	54,3	53,3
(6) Через рубцы . . . . .	1,6	—
(7) Через здоровые ткани . . . . .	44,4	46,7

Key: (1). Operating access. (2). Operated. (3). Survived. (4). Died. (5). Through wound. (6). Through scars. (7). Through healthy/sound tissues.

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Even the more indefinite point of view expressed A. V. Bondarchuk: "Relation to the anechoic suture on the whole negative. Supporter of sutures with the drainage".

The completely contradictory/opposite point of view voice neurosurgeons, who worked under conditions of the army and front line area where the flows of such wounded were considerable. Thus, N. I. Grashchenkov writes: "My relation to the anechoic suture ... unconditionally positive and, on the basis of my personal experiment/experience, I decisively insist on the anechoic suture with the early and full/total/complete neuro-surgical textbooks".

"We applied the being all-inclusive processing, cutting all over inlet to the bone together with the wound canal, then treating spine, shells and spinal cord with subsequent suturing of wound tightly", writes A. S. Orlovskiy.

Is very valuable I. S. Babchin's opinion: "Anechoic suture after the operation/process of laminectomy is necessary, especially with

the autopsy of solid cerebral shell. Unfortunately, it is possible to carry out it entirely barely, since with suturing of operating wound it is necessary to wind one-two gauze pads: one - into the angle of the sew operating wound, another - on the side through the refreshed wound or fistula course. Similarly it was operated by 81.00/o of all cases. The smooth healing of operating wound was observed into 73.80/o".

Actually neurosurgeons' majority - to a certain degree the supporters of anechoic suture. Is it possible to name/call the absence of anechoic suture stitching with the drainage (A. V. Bondarchuk) or establishment of one-two gauze pads into the angle of the sew wound and in the wound or fistula course, which is found aside? (I. S. Babchin). There is no doubt that sew thus wound incomparably more rapidly healed, than the wound, treated by tamponing. In this case it should be noted that the wounds, even which were festering after the imposition of anechoic suture, healed considerably more rapid, moreover was formed a cleaner scar.

Everything given above says in favor of the reasonable and thought-out use/application of an anechoic suture after laminectomy, to what will contribute the wide application of antibiotics.

The outcomes of laminectomy during the imposition of anechoic

suture are given in the chapter, dedicated to issues.

Pains and their treatment with the wounds of spine and spinal cord.

With the wounds of spine and the paravertebral injuries frequently were developed the pains of different types with the different localization, which gave the possibility to utilize them for the purpose of topic diagnosis.

The diversity of types and localization of pains with the wounds of spine and paravertebral depended on the fact that in this case suffered different cuts of painful route/path. The latter, as is known, it is composed of the filaments, which appear in the spinal ganglia. These ganglia are arranged/located on entire elongation/extent of spine, except rump, in intervertebral apertures. However, at the sacral unit of the spine they lie/rest within the spinal canal. From the cells of the spinal ganglia/nodes will withdraw the filaments, of which some are headed toward the periphery, forming so-called cords/beads (funiculus), and then the webes/plexi they convert/transfer into the peripheral nerve trunks. Other filaments, being headed centrally, form posterior rootlets of

spinal cord.

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The latter partly enter into the posterior columns of spinal cord and in them are raised to the medulla oblongata, where are interrupted/broken in the special nuclei/kernels. From them go the filaments to the ventral nucleus/kernel of visual mound. From the latter/last filament they are headed toward the cortex of posterior central bend. This route/path consists of the filaments, covered with the thick layer of myeline, and is the guide of tactile and deep sensitivity. Another unit of the filaments of posterior rootlets enters into the posterior crescent of the spinal cord where it is finished in its cells. The appearing from the latter filaments, after changing to other side, heave upwards, forming spine-thalamic shaft which is finished in the visual mound. The filaments, which appear here, are headed toward the cortex of upper sincipital fraction/portion. This route/path, which consists in essence of nonmyelinic filaments, is the guide of painful and temperature impulses/momenta/pulses.

The small unit of nonmyelinic filaments, which appear in the spinal ganglia/nodes, in its peripheral unit goes by special, longer method. Namely from the funicular unit of the sensitive route/path

they cross connective branches into the frontier sympathetic shaft, they pass, without being interrupted/broken to its ganglia/nodes, certain distance, and then through the connective branches they leave it, again they enter into the funicular unit of the sensitive route/path and, after interrupting in the spinal ganglia, they go in the composition of posterior rootlets into the posterior crescents of the level of these rootlets.

Thus, the unit of the nonmyelinnic filaments, which appear in the specific dermatomes, enters into the spinal cord at the level of other segments, than other nonmyelinnic filaments of the same dermatome, passing in this case the unit of the route/path to frontier shaft.

Pains with the wounds of spine can appear, first of all, during the damages/defeats of posterior rootlets, spinal assemblies and funicular unit of the sensitive route/path. This education sometimes was destroyed both with the penetrating wounds of spine and with the nonpenetrating ones, for example, with the breaks of the extensions of vertebrae, during the hemorrhages into the sub-arachnoidal space.

During the damage/defeat of these all three cuts of sensitive route/path is characteristic for the pains their topography. Pains are spread with respect to the topography of separate posterior

rootlets, i.e. in the form of the bands whose boundaries go perpendicular to spine. On the body painful zones have therefore the form/species of the bands, which encircle it, on the extremities - form/species of the bands, which go from the central to the peripheral unit extremity. Pains during the damages/defects of three cuts of sensitive route/path indicated in the majority of the cases have "somatic character/nature". The limitedness of painful zones sharp, localization of injection precise, etc.

In the unit of the cases of pain they carried the shooting character/nature, i.e. pains appeared in the form of the attacks/seizures/paroxysms of different duration, which were being alternated with the periods of rest; during the attack/seizure/paroxysm the pain was continuous. Patient tested/experienced the pain, which was lasting several seconds and even it is less, then followed free from the pain time interval, and then again appeared the perception of pain. Perception this appeared usually in the very restricted sector of body, for example, in one toe. In the unit of the cases it appeared repeatedly in the same sector, in other cases with each painful jerk/impulse the perception appeared in the different sectors of body, for example, then in one, then in other sector of skin of thigh. Patient tested/experienced perception, as if from time to time him they hit by knife or poke into the body needle.

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The pains of the shooting character/nature in the immense majority of the cases were developed during the damage/defeat of posterior rootlets, but not spinal assemblies, and funicular unit of the sensitive route/path. Some authors consider them even absolutely pathognomonic for the damage/defeat of rootlets.

During the damage/defeat of spinal ganglia/nodes in the corresponding dermatome frequently was developed the shingles. It is doubtful so that it could be developed during the damage/defeat of the radicular and funicular part of the sensitive route/path.

Thus, the existence of somatic type pains with the radicular localization made it possible to make a conclusion about the damage/defeat of posterior rootlets, spinal assemblies or the funicular part of the sensitive route/path. The presence in this case of the shingles spoke for the damage/defeat of spinal ganglia/nodes, and the shooting character/nature of pains - for the damage/defeat of posterior rootlets.

"Vegetative" or causalgic type pains during the damage/defeat of



the education indicated were developed rarely. Pains and other pathological phenomena with this localization of focus, as a rule, are less intense than with causalgic syndromes, which develop with the wounds of peripheral nerves. Most frequently vegetative type pains were developed during the damage/defeat of the radicular unit of the route/path, especially lumbar-sacral rootlets, which generate horse tail. The reason for this, possibly, is the fact that the myelinic and nonmyelinic filaments, mixed in funicular part of the sensitive route/path, further, in that unit of the posterior rootlets where it approaches the spinal cord, they are divided into two units: the more medially grouped myelinic filaments, which enter then into the posterior column of spinal cord, and the more lateral nonmyelinic filaments, which enter then into the posterior crescent of spinal cord.

This creates the possibility of the isolated/insulated damage/defeat of nonmyelinic, that carry painful impulse/momentum/pulse, filaments, what is the condition for the appearance of vegetative type pains.

Thus, the appearance of vegetative type pains with the wounds of spine speaks for the damage/defeat faster posterior rootlets, than spinal ganglia/nodes or funicular part of sensitive route/path.

The completely special group of pains, which has great practical value, forms the pains, which depend on the damage/defeat of the radicular and funicular part of the sensitive route/path, which develop with diskitis. The essence of morbid process in this case consists of the incomplete or full/total/complete break of dense connective annulus (annulus fibrosus), which encircles the semiliquid chondral nucleus/kernel (nucleus pulposus) of the intervertebral cartilage. In this case through the formed in the annulus apertures is stuck out the chondral mass, which exerts pressure on the spinal rootlets, forcing them against yellow ligaments and small arcs of spine.

Clinically, the gap of connective annulus becomes apparent by surprise development of extremely intense pains in the appropriate region of spine. In the immense majority of the cases these pains appear in the lumbar region, since into 90.00/o of all cases are destroyed the disks between the IV and V lumbar vertebra or between the V lumbar vertebra and the rump.

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The relative diffusivity of pain with the restricted sizes/dimensions of focus is explained by the fact that the sensitive innervation of the intervertebral cartilage and its covering

posterior longitudinal ligament of spine occurs due to the tunicary branch (rami meningei) of spinal nerve. But each tunicary branch, after entering through the intervertebral aperture the spinal canal, innervates ligamentous/connecting apparatus and solid cerebral shell not only at the level of its vertebra, but also not the level of one-two vertebrae above and below. Because of this the stimulation of nerve ends in the ligaments at the level of one vertebra it conditions pains at the level not only of this vertebra, but also several vertebrae, which lie above and below it.

Simultaneously with the pains with lumbar diskites appears the sharp lumbar muscle tension. This voltage is developed reflector, i.e. it is the reflector contracture, which depends on the damage of sensitive terminations in the intervertebral cartilage and the ligament of spine.

The attacks/seizures/paroxysms of pains in the loin are developed usually sharply, suddenly, are continued 5-10 days, and then disappear or weaken. But later they again are repeated, appearing with physical stress or during infection, and sometimes also without the visible external reason.

Pains are initially limited to lumbar sphere, and then they begin to be spread over the posterior surface of thigh and over the

posterior or external surface of shin to the foot and the fingers/pins, i.e. is developed the picture of ischialgia. Is characteristic for these pains the fact that they, as a rule, correspond to the zone of the innervation only of one rootlets. During the damage/defeat of the intervertebral cartilage, which lies between the IV and V lumbar vertebra, is destroyed the V lumbar rootlets. Pains in this case are spread, besides thigh and shin, to the middle part of the back surface of foot and the II-IV finger/pin. During the damage/defeat of the cartilage, which lies between the V lumbar vertebra and the rump, is destroyed the first sacral rootlets. Pains in this case, besides thigh and shin, apply to the external unit of the foot and the V finger/pin. During the damage/defeat of cartilage of the IV and V lumbar vertebra of the achilles reflex can drop out. Sensitivity in the zone of the affected rootlets can be reduced.

This picture of mono-radiculitis, i.e. the damage/defeat of one rootlets in the absence of changes in the spine, is so characteristic for diskitis that on the basis of its one it is possible to assume this process, whereas contrast X-ray analysis gives the possibility to establish/install it with the authenticity.

In the initial periods of diskitis when still there is no full/total/complete ring cleavage and there is only the diverticulum

of the cartilage through the fibrous tissue of annulus, can be useful conservative therapy, especially physiotherapy. However, in further period of the disease when annulus is already torn and chondral mass squeezes rootlets, whereas conservative therapy usually weakly acts, surgical intervention in the form of the resection of the projecting chondral mass, as is known, in the immense majority of the cases it leads to the full/total/complete recovery.

Diskites can be developed, also, without the injury, it is especially in persons older than 50 years. But especially frequently are developed they after the dull injury of lumbar region. A considerable quantity of post-traumatic neuralgia relates precisely to this form of ischialgia. Therefore in each case of the ischialgic syndrome, which developed after the injury where the roentgenological examination/inspection does not give indications of the breaks of small arcs and bodies of vertebrae, it is necessary first of all to think about the possibility of traumatic diskitis.

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The damage/defeat of the posterior crescents of spinal cord can be escorted/tracked by painful sensations. The isolated/insulated damage/defeat of posterior crescent, without the damage/defeat of other units of the sensitive route/path, is observed with central

hematomyelia, with which the favorite place of hemorrhage is the front/leading or posterior crescent of the thickenings of spinal cord. Pains in this case carry usually somatic character/nature.

In some cases they can have radicular character/nature, in others they apply to the separate segments of extremity, for example, to the hand, the forearm, etc. The reason for the existence of these two types of localization of pains during the damage/defeat of posterior crescent consists in the fact that with the focus in the extremital unit of the posterior crescent are destroyed the filaments of posterior rootlets, which entered the posterior crescents; topography of pains in such cases has radicular character/nature. However, during the damage/defeat by ventral, front/leading, unit of the posterior crescent are destroyed predominantly the cells of posterior crescent, about which are finished these filaments. The cells of posterior crescent are arranged/located so that the groups, which lie more ventral, innervate the more extremital units of the extremities, arranged/located more dorsally - more center sections of the extremities. Thus, for instance, in the posterior crescent at the level of the lower unit of the neck thickening more dorsally lie/rest cells for the forearm, and more ventral - for the hand. The damage/defeat of different divisions of the cellular groups of posterior crescent is escorted/tracked therefore by the pains, which apply to the separate segments of extremity.

The damages/defeats of spine-thalamic shaft for entire its elongation/extent are escorted/tracked by pains, if its filaments are not interrupted/broken, but they are only irritated pathological by process. This was observed during the penetrating wounds of spine, the closed breaks of spine and the sub-arachnoidal hemorrhages, caused by the dull injury of spine.

With the one-sided localization of the pathological process of pain they appear in one half body, namely on the side, contradictory/opposite to focus. If simultaneously suffers the corticospinal tract of the same half spinal cord, then is developed Brown-Sekarovskiy syndrome with the painful phenomena on the side, contradictory/opposite to focus.

During the bilateral damage/defeat of spinal cord the pains are bilateral.

Upper boundary of painful zone lies/rests usually to 1-2 dermatomes of lower than the level of focus but cases occur when it lies/rests considerably below. For example, with the focus at the level of a sixth-seventh thoracic segment upper boundary of painful zone goes on the inguinal fold. Depends this on the fact that in

spine-thalamic route/path, as is known, the filaments, pulse carrier from the more extremital extremities, lie/rest nearer to the periphery of spinal cord, than the filaments, pulse carrier from the more central divisions of the same extremity. Because of this during the stimulation at any level not of all filaments of a spine-thalamic route/path, but their only units, which lies nearer to the surface of spinal cord, pains appear only in the more extremital divisions of extremity. However, with the injuries of spinal cord, escorted/tracked by stimulation filaments of spine-thalamic route/path, the source of stimulation, as a rule, lies/rests out of the spinal cord, in consequence of which is developed the stimulation of the surface strata of spine-thalamic shaft.

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Pains during the damage/dereat of this beam usually have somatic, and in the rare cases and vegetative character/nature. Probably, this is explained by the fact that spine-thalamic shaft, besides a large quantity of nonmyelinic filaments, which conduct painful impulses/momenta/pulses, contains a small quantity of filaments with the thick layer of myeline, which conduct tactile impulses/momenta/pulses. These filaments lie/rest more toward the front, and bare axial cylinders - toward the rear from them. Because of this with the foci, arranged/located more toward the rear, is



created the possibility of the isolated/insulated stimulation of nonmyelinic filaments, in consequence of which appear vegetative type pains. In certain cases in patients not perceiving pain upon the examination/inspection of painful sensitivity by the method of the injection by stickpin, is detected the existence of hyperpathic zone of lower than the focus. This isolated/insulated existence of hyperpathia, without the pains, is most frequently conditioned on the damage/defeat of the posterior columns, which contain myelinic filaments. By this focus is created the zone where were preserved some nonmyelinic filaments alone, that also leads to the development of hyperpathia.

The same origins and hyperpathia with the classical form of Brown-Sekarovskiy syndrome.

Are encountered the cases when that isolated/insulated hyperpathia is developed without the damage/defeat of posterior columns. In similar cases there is an interruption of filaments of the front/leading division of spine-thalamic shaft, i.e. its division, which consists of myelinic filaments, with the integrity of the filaments of its posterior division, i.e. nonmyelinic.

Extremely intense and peculiar pains appear during the damage/defeat of that unit of the painful guides that pass through

the frontier shaft, i.e. during the damage/defeat of frontier shaft and its connective branches.

Since frontier shaft lies/rests on anterolateral of the surface of spine, then different character/nature of its damage both penetrating and nonpenetrating, are escorted/tracked by the damage of frontier shaft.

Since in the frontier shaft and its branches the filaments, which carry sensitive impulses/momenta/pulses, almost everyone relates to a number of painful guides and it is nonmyelinic, then precisely during the damage/defeat of frontier shaft and its branches pains carry the most sharply pronounced vegetative character/nature. They are intense, burning, permanent, affectively painted. During the investigation of painful sensitivity are detected the characteristic phenomena: duration of pain after single injection, its inaccurate localization, the riches escorting/tracking pains of effector-vegetative reactions, etc. Is extremely typical, even pathognomonic, the topography of these pains. It corresponds not to the zones of the innervation of peripheral nerves or rootlets, but to the zones of the innervation of the separate ganglia/nodes of frontier shaft or their separate groups. Namely during the damage/defeat of upper neck sympathetic ganglion/node pains apply to the half head and neck to the collar bone. During the damage/defeat

of stellate ganglion they applies to hand, neck and upper half chest to the VI-VIII edge/fin. During the damage/defeat of any thoracic ganglion/node they are spread usually to the appropriate dermatome and to 2-3 dermatomes, above and below arranged/located. However, during the intense stimulation of any thoracic ganglion/node the pains can be disseminated also to all dermatomes, innervated by thoracic ganglia/nodes, i.e. to entire chest and stomach. During the damage/defeat of lumbar and sacral ganglia/nodes feeble pains apply to the appropriate dermatome and on 2-3 adjacent to it, whereas are more severe pains - to entire region of the innervation of these ganglia/nodes, i.e. to the lower extremities and the lower unit of the stomach to the level of navel.

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The noted above topography is characteristic for the stimulations of the cellular elements/cells of sympathetic ganglia. But if the phenomena of stimulations are developed also in the filaments, passing through the ganglion/node, painful zone is increased still more. For example, during the process, which calls the stimulation not only of the cellular elements/cells of stellate ganglion, but also painful filaments, passing through it and guiding toward the upper neck sympathetic ganglion/node, pains they are developed in the territory of the innervation not only of stellate

ganglion, but also upper jugular gland, i.e. on the entire upper half body - from the head to the VI-VIII edge/fin.

During the partial damage/defeat of the cellular elements/cells of ganglion/node the pains are developed in the unit of the territory, innervated by this ganglion/node. The boundary of painful zone forms in such cases the line, perpendicular to the longitudinal axis of extremity, in other words, painful zone it takes the form of glove, stocking, etc.

Besides this peculiar topography of pains, is extremely characteristic for the damage/defeat of ganglia/nodes the dynamicity of these violations in the relation to their topography: the violations of innervation are developed into some cases first in the zone, which accurately corresponds to the region of the dissemination of the branches of the affected ganglion/node, and then gradually apply to the adjacent zones as a result of the transition of stimulation from the affected ganglion/node to the adjacent ones; for example, during the damage/defeat of stellate ganglion the pains appear first at the skin of hand, and then apply to skin of body and foot of the same half body.

In other cases the irradiation of pains is developed sharply, in the form of peculiar crises, for example, during the damage/defeat of

stellate ganglion appear paroxysmal pains at the skin of upper extremity. Through several minutes these phenomena begin to apply to skin of body, and then lower extremity. After achieving the maximum after 10-20-30 minutes, these phenomena gradually begin to weaken, moreover, first of all, they disappear, where they appeared last of all. Is obtained the extremely peculiar picture, which reminds the picture of Jackson sensitive epilepsy, i.e. the stimulation of crust sensitive centers. The difference between these two syndromes consists in the fact that the duration of "junction/unit epilepsy", if it is possible then to name/call, it is much more than epilepsy of the crust: with the junction/unit it is equal to 20-30-40 minutes, whereas with the crust - to several seconds.

In the unit of the cases the phenomena of irradiation capture internal organs/controls; for example, with the foci in stellate ganglion during the crisis appear the urges for the urination and the defecation.

The mechanism of a similar crisis is reduced to the process of the irradiation of excitation from the affected ganglion/node to the healthy/sound ones. Irradiation occurs along the short systems of frontier shaft, which join its separate ganglia/nodes.

The special group of symptoms during the damage/defeat of the

ganglia/nodes of frontier shaft compose pains in the internal organs/controls, innervated by the affected ganglia/nodes. Thus, for instance, with the wounds of stellate ganglion can be developed intense pains in the region of heart. In certain cases of pain these, escorted/tracked by a feeling melancholy and fear and appearing it is paroxysmal, they can give the clinical picture, which extremely reminds stenocardia. The mechanism of the origin of these phenomena is clear: with the stenocardia, as a result of ischemia of heart muscle, are irritated visceral receptors, in it which are located, whereas during the damage/defeat of stellate ganglion are destroyed the filaments, which bear impulses/momenta/pulses of the heart, since these filaments, as is known, they pass through stellate ganglion.

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Besides pains, during the damages/defeats of the ganglia/nodes of frontier shaft are developed also the damage of vegetative-effector innervation of organs/controls and tissues, innervated by the affected ganglion/node, what causes the violations of structure and function of these education - skin with its appendages, muscles, joints, fascias, bones and internal organs/controls.

On the whole to establish/install the damage/defeat of frontier

shaft, even on the basis of one character/nature of pains, presents no difficulties. Pains with the injuries of spine can appear as a result of the damage/defeat of the terminations of painful filaments, which are located in the arranged/located here tissues of spine, its ligaments, shells of brain and in the tissue of the spinal cord.

The pains, which appear with the wound of spine, its ligaments and solid cerebral shell as the damage/defeat of other tissues of body, innervated by painful filaments and filaments, which conduct the impulses/momenta/pulses of a deep sensitivity, have a character/nature of somatic pains, i.e. their localization corresponds to the disposition of pathological process. Are such the pains, which appear with the injuries in the education of victims from the injury, for example, those pains, which the patient after the break of the body of any vertebra tests/experiences in this zone.

It is necessary, however, to note that also with this localization of focus sometimes is observed the sufficiently considerable irradiation of pain, for example, with the permanent pain in the region of any victim of vertebra the pain at times irradiates upward and downward on the spine. The laws, which are determining the direction of the irradiation of these pains, which do not depend on the damage/defeat of the passing here rootlets, are sufficiently complex and still little studied. It must be noted that

the mechanism of the origin of these irradiation, apparently is identical to the mechanism which determines the existence of painful irradiation during the damage/defeat of internal organs/controls. Similarly how with the disease of heart pain can irradiate into the hand, and with the diseases of the liver - into the spatula, in exactly the same manner with the disease of spine, its ligamentous/connecting apparatus and solid cerebral shell pain can irradiate into different sectors of body, mainly into different sectors of the tissues, which cover spine.

In the majority of these cases maximum intensity the pain has, however, at the level of focus, that also gives possibility on the basis of pain to judge its localization.

Arachnoid shell contains neither nerve ends nor nerve fibers, in consequence of which the pains cannot appear in it.

Within the spinal cord the ends of bare axial cylinders, i.e. painful receptors, are located only in the walls of vessels, especially in their adventitia. This creates the possibility of the onset of pains during the pathological processes and within the spinal cord as a result of the stimulation of these terminations.

In the soft shell painful sensations in essence are concentrated



also in the walls of vessels. The semiotics of their damages/defeats, it is probable, the same as the vessels of spinal cord.

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As is evident from all that presented above, the damage/defeat of different sectors of sensitive route/path in the spinal cord and in its paravertebral division, and also the damage/defeat of the painful receptors of the spinal cord, its shells and spine they give the very diverse in the character/nature and the topic of painful syndromes whose study can contribute to the establishment of topic diagnosis.

Because of this during the spinal and paravertebral wounds and the damages it is necessary to thoroughly study complaints of the pains with the subsequent study of the pains, called upon the examination/inspection of sensitivity.

It is necessary in this case to have in mind that investigated sometimes carry to a number of pains of compression and circling, running goose pimples, and also other paresthesias. But all these perceptions appear as a result of the stimulation not of painful routes/paths, but routes/paths of tactile and deep sensitivity. Because of this their analysis, possible and necessary, furnishes

information on about the condition of the routes/paths of tactile and deep sensitivity, but painful.

The basic condition of effective struggle with the pains, which appear with wounds and damages of spine and paravertebral, is the differentiation of two types of pains - somatic and vegetative.

With somatic type pains can be applied different pain relievers and physical therapy agents of all types - thermal procedures, electroprocedures, balneological methods, etc., in the heavy cases should be applied the treatment by prolonged sleep. In the firmest, not yielding to conservative therapy cases can sometimes arise the need for a chordotomy, i.e. in the cutting of a spine-thalamic route/path in the spinal cord. Performing this operation/process, it is necessary, however, to have in mind that the condition of its effectiveness is the cutting of spino-thalamic route/path not at that level, where enter into the spinal cord the rootlets, which associate upper boundary of painful zone, but by 5-6 segments it is higher. For example, with the pains in the region of lower extremities and stomach to the level of navel it is necessary to operate not at the level of the tenth thoracic segment, but at the level of third-fourth thoracic segment. Depends this on the fact that the unit of the filaments on which go painful impulses/momenta/pulses from the posterior rootlets as this was shown above, enters into the frontier

shaft, in it heaves on the elongation/extent of 4-5-6 segments and, once at this level, the connective branches it converts/transfers into the posterior rootlets and enters with them into the spinal cord. Furthermore, the unit of the filaments from the posterior rootlets converts/transfers in the web/plexus of aorta and in it heaves on the elongation/extent of several segments, and then it enters into the spinal cord. Finally, the unit of the painful filaments heaves upward and in the web/plexus, arranged/located in the epidural space.

Thus, variously the unit of the filaments, which go in the posterior rootlets, extraspinal passes for the elongation/extent of several segments upward, and then already it enters into the spinal cord.

Therefore in order to interrupt routes/paths for all morbid impulses/momenta/pulses, it is necessary to operate with the chordotomy by 4-5-6 segments higher than upper boundary of painful zone. It is necessary to also operate bilateral, since the filaments, which carry pains of each half body, pass into composition of both spino-thalamic shafts. Finally, cut it is necessary to make sufficiently deep, that reaches the gray substance of spinal cord, especially when pains are also in the region of body, since the filaments, which carry pains of the body, lie/rest deeply.

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Under these conditions the chordotomy removes usually even most intense pains in the lower half body. With the pains in the region of the upper extremities of useful there can be the chordotomy at the level of the third and fourth neck segment, which, however, presents considerable dangers.

With vegetative type pains the soothing substances, even morphine, they do not give usually essential effect as the majority of physical therapy procedures. With the sharply pronounced causalgic character/nature of pain all procedures, which call the heating of the affected unit of the body, frequently even amplify pains. Most usefully usually in such cases the action on the appropriate sympathetic ganglia/nodes by the method of their novocaine blockade. Paravertebrally is introduced 10-15-20 cm<sup>3</sup> 0.50/o solution of novocaine into each assembly. With the pains in the upper extremity they usually block stellate ganglion. On the basis of the principle of preganglionic action, they block the fifth, sixth and seventh thoracic ganglion/node and are obtained with this procedure the same results, as from the blockade of stellate ganglion, but without the complications.

With the pains in the region of lower extremities they usually block by the second and the third lumbar ganglion/node.

With the pains in one lower extremity it is better to block ganglia/nodes of both sides, since in the lower extremity sympathetic innervation occurs bilateral.

Blockades it is necessary to produce repeatedly 3-5 or more times after 2-3 days. Repeated blockade frequently gives effect even when single gives nothing or its effect it proves to be very short-time.

Good results gives treatment by prolonged sleep.

If vegetative type pains are very intense and do not yield to treatment by blockade and sleep, it is possible during the damage/defeat of upper extremity to remove the third thoracic ganglion/node, but during the damage/defeat of lower extremity - by the second or the third lumbar.

Physical and balneotherapeutic methods of the treatment of the injuries of spine and spinal cord.

The wounds of spine and spinal cord, its shells and rootlets occupy special position/situation among other means of wounds.

If in the latter/last decades changed surgical tactics in the relation to wounded the spine and the spinal cord, fixture of more active, then conservative therapy, in particular, physiotherapy, went by new routes/paths; it were adopted not only during the treatment of consequences injuries in chronic invalids, but frequently, also, in the subacute (but sometimes also in the sharp/acute) period of disease/sickness/illness/malady.

In a new way began to estimate the practical value of the preventive use/application of therapeutic gymnastics in the early stages of process for the purpose struggles with paralysees, contractures.

The contemporary methods of physiotherapy (USF therapy, paraffin therapy, ozoceritotherapy, ultraviolet erytherotherapy) were used extensively during wounds and damages of spine for the purpose of active action on the processes of resorption, on the regenerative

processes, on the painful syndrome, on the trophic disorders.

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With the wounds of spine and spinal cord the methods of physiotherapy, therapeutic exercise and ergotherapy found to themselves a use in the hospitals of front line area, in the rear hospitals, in the profiled research institutes (institutes of traumatology and orthopedics, institutes of physiotherapy and health resort science), in the sanatoriums and on the health resorts. In the majority of the cases these methods were applied complexly; they were the necessary supplement to surgical interventions, which played the dominant role.

The methods of physiotherapy were applied as in the pre-operation period, so especially in the post-operation period, and also when surgical intervention was considered counter-indicative either on to those or other reasons impracticable ones.

The basic problems which stood before the conservative therapies of the wounds of spine and spinal cord, they were reduced: to the removal of the exudate from the stricken area (reabsorbing, antipyretic and analgesic activity); the stimulation of the processes of regeneration of the tissues, the massages of horse tail and

rootlets of spinal cord; to action on the motor, sensitive and trophic disorders; to action on the painful syndrome; to the treatment of the damage of the functions of pelvic organs/controls; to prophylaxis and to treatment of bedsores; to prophylaxis and to treatment of contractures and faulty positions/situations; to action on the painfully changed muscular tone; to prophylaxis and treatment of trophic disorders and to increase in the general/common/total tone of organism and its shielding properties.

A physio-balneotherapy of the wounds of spine and spinal cord is designed in the overwhelming majority of the cases for its use/application during the prolonged period, since the process of reduction of the fallen motor and sensitive functions, even which were yielding to reverse development, proceeded extremely slowly. In view of this here was required the specific plan/layout and the system of the treatments, calculated not only for the months, but sometimes and for the years. With the heavy wounds of the spine and the spinal cord, which involved deep anatomical and functional changes, the role of physiotherapy was reduced to the elimination of separate symptoms, to prophylaxis of the faulty positions/situations of extremities, to weakening or eliminating the disorders of pelvic organs/controls, for prophylaxis and treatment of bedsores, etc.

The wounded during treatment of whom equipment physical therapy



methods or extra-health resort balneoprocedures (mud cure, artificial hydrogen sulfide baths, chloride-sodium, radon baths, etc.) proved to be barely effective, they guided to the appropriate health resorts. In a sizable quantity of cases health resort treatment of these, it seemed, hopeless patients gave surprisingly good results.

Especially should be noted the salient therapeutic value for this group of such sick health resorts as Pyatigorsk, Sochi-Matsest, Tskhaltubo, Sergiyevskiy mineral waters, Evpatoria, where in many patients with the damage of spine and spinal cord attacked/advanced a considerable improvement in both general condition and series/number of morbid symptoms.

Among the methods of balneotherapy the special importance during the years of the Great Patriotic War acquired the mud cure which with the wounds of spine and spinal cord was used extensively not only at mud cure health resorts, but also in the extra-health resort circumstances, utilizing imported mud/contamination.

V. A. Aleksandrov theoretically based the therapeutic value of mud/contaminations, after coming to light/detecting/exposing their general biological activity on the organism, and their also reabsorbing, soothing and reparative activity during different inflammatory processes, which appear with the wounds of spine and

spinal cord. By these properties of therapeutic mud/contaminations are explained wide readings to their use/application with the wounds of spine and spinal cord.

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With the wounds of spine, which were complicated by the osteomyelitic process, the mud cure effectively was applied in the evacuation hospitals and on the special mud health resorts. T. S. Zatsepin and Kh. M. Freydin considered that for the mud cure with the wounds of spine were shown organized in the post-operation period hematomas, inflammatory processes, bullet osteomyelitis of spine both closed and with the fistulas, the long not healing wounds and ulcers, ankylosing spondylarthrititis, spondyloses.

Mud cure found use, also, with the wounds of spinal cord, its shells and rootlets, hematomyelia after passing sharp/acute period, during Rubtsovs's lifetime education, local edemas, radiculites, various forms of motor disorders - paralyses and paresis, contractures, etc.

During the same readings, together with the mud cure, was applied paraffin and ozocerite. The medicinal properties of paraffin as a medium for transferring thermal energy were known as early as

World War I, but paraffin began to be widely used primarily in the Great Patriotic War. This was considerably affected by the careful study by a number of Soviet authors of paraffin as a heat carrier, among whom great initiative was demonstrated by A. R. Kirichinskiy et al. The effectiveness, simplicity of the procedure for applying it, and portability especially contributed to its wide use.

Application of paraffin along the spine or to the paralyzed extremities, and to the reflexogenic zones also gave a good therapeutic effect in the sense of action both on the morbid focus and on the separate symptoms. With the pains and the contractures the use/application of paraffin was not less effective.

The advantage of paraffin therapy consisted in the possibility to apply paraffin of higher temperature than mud/contamination or peat. This advantage of paraffin successfully was utilized when it was necessary to apply intense thermal effect on the foci of destruction and inflammation, if it was necessary to increase the processes of resorption and to activate/promote local roof and lymph circulation.

One of the varieties/subspecies of paraffin therapy was the proposed in the beginning of the Great Patriotic War treatment paraffin-butyric mixture.

The paraffin-butyric mixture Lepskiy consists of 750/o of paraffin and 250/o of fish oil. Its therapeutic value consists in the fact that, besides paraffin, here exerts effect and fish oil,

exhibiting in this case the inherent in it therapeutic properties: bactericidal activity, effect of vitamins A and D. Paraffin-butyric mixture extensively is used as very effective substance for the purpose of prophylaxis and treatment of bedsores. Exerting the soothing activity, without adhering to the surface of bed sore, paraffin-butyric mixture contributes to the rejection/separation of necrotic tissues and is exerted the stimulating activity on the processes of the regeneration of granulating tissue and mainly for the epithelization.

Heavily wounded the spinal cord, so the painfully transferring dressings during the treatment of bedsores, tested/experienced large alleviation during the use/application of the paraffin-butyric bandages which not only freed them from the morbid perceptions, but also contributed to the fastest healing of bedsores.

Sizable value had the preventive utilization of paraffin-oil mixture for the purpose of preventing the formation of bedsores.

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For this in the typical places the education of bedsores (to the rump and to the heels) laid the gauze packing, which consists of 6-8 layers of gauze, impregnated with paraffin-butyric mixture. The

timely imposition of this bandage, its frequent exchange (after 3-4 days) in many instances prevented the education of bedsores. The procedure of the treatment of the already formed bedsores consisted usually in the following: after the appropriate processing the place of bed sore they irradiated by ultraviolet rays, applying in the period of necrotization from 5 to 10 biodeses, and in the period of epithelization - from 1 to 3 biodeses. After ultraviolet lighting the region of bed sore they sprinkled by white streptocide and poured by drop method by the paraffin-butyric mixture of temperature of 45-50°. When was formed film, laid 2-3 gauze towels, impregnated with paraffin-butyric mixture, and thin layer cotton. During the epithelization the powder by white streptocide no longer they produced, but paraffin-butyric mixture either was deposited by pulverizer or were laid the impregnated with it gauze towels.

The exceptional effectiveness of this procedure of the treatment of bedsores was observed in many instances.

Besides paraffin and its varieties/subspecies (paraffin-butyric mixture, ambrine), during the years of the Great Patriotic War during the treatment of wounds and damages they were adopted the ozocerite whose therapeutic properties were opened for the first time in the Soviet Union in 1942 by Prof. S. S. Lepskiy.

Ozocerite, ozocerite, the mineral of petroleum origin.

Ozocerite occupies the first place among the heat-transfer agents according to its thermal properties. Its advantages include high heat capacity and large heat-holding ability.

Furthermore, as subsequently it was explained, ozocerite possesses still and other therapeutic properties, caused by the chemical special features/peculiarities of its composite/compound component parts.

The basic therapeutic properties of ozocerite, its antipyretic, reabsorbing and soothing activity found multifeature and wide application during the treatment of the motor, sensitive and trophic disorders of spinal cord. Especially one should emphasize the exceptional reabsorbing activity of ozocerite which repeatedly was confirmed during the direct application of ozocerite in the place of trauma, in the region of morbid focus. The resorption of hemorrhages, necrotic tissues, Rubtsovs of education, etc. flowed/occurred/lasted under the activity of ozocerite frequently is very effectively, also, in comparatively short periods.

Patients transferred well application of the ozocerite even higher temperature (60-70°), which had the high value during the

treatment of the wounds of spine and spinal cord.

Particularly should be emphasized the favorable activity of ozocerite during the treatment of contractures. Observations (Central institute of traumatology and orthopedics, Ukrainian balneological institute in Odessa) showed that application of ozocerite very beneficially influenced the contractures of different origin, in particular, to the contractures of separate joints, which were being observed with the wounds of spine and spinal cord. Here played role not only improvement in the blood supply in the injured/damaged muscular groups, but also direct effect of ozocerite on the plastic muscular tone.

The soothing activity of ozocerite was utilized in the struggle with the painful syndrome which with the wounds of spine and spinal cord very variable both on the genesis and on the clinical special features/peculiarities. When pains were conditioned on pressure on the rootlets of Rubtsovs of the education of small hematomas where there were damages of frontier sympathetic shaft (when pains carried especially caustic character/nature), during the damages of horse tail and the dissemination of process to entire peripheral neuron, physical methods of the treatment generally, in particular application of mud/contamination, paraffin and ozocerite, frequently gave good results.



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Therapeutic effect depended on procedure and dosage of procedure. The moderate heat had the considerable advantage before the intense thermal effects. Furthermore, extra-focus actions according to segmental-reflector principle of Shcherbak are more preferable than the focus actions which frequently amplified pains and was caused the increased irritability.

Equal with the mud cure, paraffin and ozoceritotherapy in the years Great Patriotic War extensively was used peat treatment, for which were utilized mainly local peat resources/lifetimes. Procedure and reading to peat treatment the same as with the mud cure. The effectiveness of peat treatment with the traumata of wartime is confirmed on the vast clinical material.

From the methods by equipment for physiotherapy during wounds and damages of spine and spinal cord it was extensively used ultraviolet lighting, currents of low voltage in the form of galvanization, ionogalvanization of different medicinal substances, faradizations, high-tension currents and large frequency in the form of diathermy and <sup>UHF</sup> ~~RF~~ therapy.

Prof. A. V. Rakhman demonstrated in the experiments on animals and in the clinic the elective activity of ultraviolet rays on the ectodermal tissues.

Almost with all wounds, especially with the long not healing wounds and the ulcers, ultraviolet rays, as a rule, applied in the process of educating of granulations and epithelization.

The bactericidal activity of ultraviolet rays was utilized with the wounds of spine and spinal cord, entailed education infected wounds, fistulas, long not healing wounds and trophic ulcers. For this purpose were applied both local irradiations and extra-focus in the erythematous and weak dosage, in the dependence on the readings. Ultraviolet lighting contributed to the cleansing of wound, to melting and rejection/separation of necrotic tissues, exerted in the complex with the sulfamide preparations bactericidal and bacteriostatic activity. In the stage of the healing of wounds the ultraviolet rays stimulated epithelization and contributed to the education of dense, good scar.

Ultraviolet lighting was applied also during the treatment of bedsores for the purpose of their decontamination from the necrotic

tissues, the acceleration of the education of demarcation line, stimulation of epithelization and cicatrization. In these cases ultraviolet lightings were applied in the complex with the ointment bandages (ointment of Vinyovskiy, fish oil, paraffin-butyric mixture, etc.), which usually led to a comparatively rapid healing of bedsores.

Ultraviolet lighting was applied with the wounds of spine and spinal cord and for dealing with the painful syndrome. With the pains were applied several variants of localization of ultraviolet lightings: to the zone of the dissemination of pains, to segmental-reflector zone and the combined action - local and segmental-reflector.

Thus, during the damage/defeat of upper neck sympathetic ganglion/node they irradiated the appropriate half head and neck to the collar bone; during the damage/defeat of stellate ganglion - hand on the appropriate side, neck and upper division of chest - to the VI-VIII edge/fin, during the damage/defeat of thoracic ganglion/node - zone by 2-3 dermatomes above and below the appropriate dermatomes.

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Simultaneously irradiated skin integuments along the spine at

different height.

With the shingles (during the damage of cerebrospinal ganglia) ultraviolet lighting was applied at the erythematous doses both to the zone of rash and to the appropriate segments of spinal cord.

During funicular damages/defects the gates of entry of skin integuments along the appropriate peripheral nerve by rectangular sectors from 150 to 300 cm<sup>2</sup>. In these all cases were applied erythematous (but not hyper-erythematous) dosages, moreover between the separate performances of irradiation there were interruptions 3-4 days.

Casualties usually withstood well ultraviolet lightings which rarely caused the aggravation of pains, and larger partly, on the contrary, similar to novocaine blockade muffled pains, they weakened/attenuated them, and they sometimes removed completely.

Following on the practical significance physical therapy by methods which had extensive application with the wounds of spinal cord, its shells and rootlets, was electrotherapy in the form of galvanization, ionogalvanization of medicinal substances, faradization, diathermy and UHF therapy.

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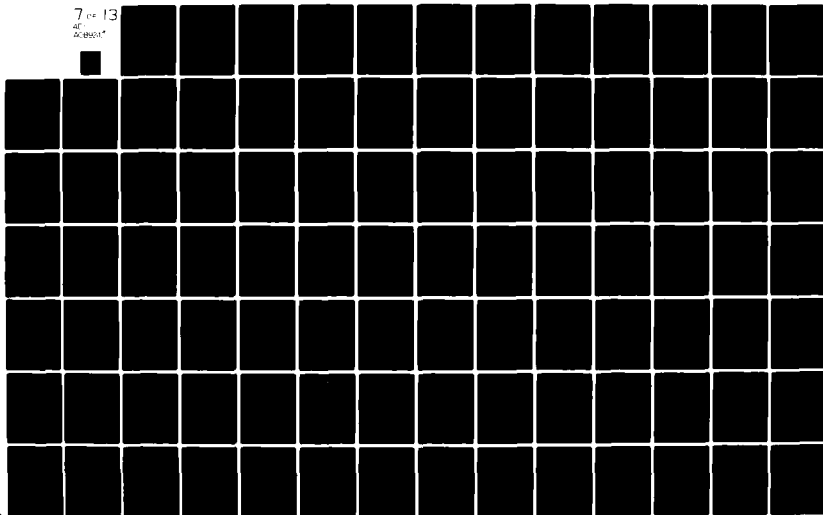
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Galvanization was applied in the form of the imposition of metal electrodes on the humid packing, and also in the form of chamber baths. The same methods they put to use also with the ionophoresis of medicinal substances, only packing impregnated under the appropriate poles with one or the other medicinal substances or the latter added to the chamber baths. Galvanic current just as faradic, was applied also for rhythmic electrogymnastics of the paralyzed muscles. The selection of one or the other form/species of current, and also the polarity of electrodes were determined depending on data of electrodiagnostics. Was applied that form/species of the current, with which were obtained muscle contractions. As the active electrode was selected that pole, with which were obtained under the smallest current strength the first, sharpest muscle contractions. In the presence of the degree of reaction advancement the regenerations preference gave up to stable galvanization and ionogalvanization of medicinal substances. From the medicinal substances widest application found potassium iodide in 20/o solution/opening, calcium chloride in 1-20/o solution/opening, 10/o solution (on to alcohol) of novocaine, solution of histamine (1:10000), solution of dionine (1:1000), 0.25-0.50/o solution of zinc sulfate, etc.

Ionogalvanization of potassium iodide it was applied predominantly for the resorption of the remainders/residues of the hemorrhage, Rubtsovs of education, organized infiltrates, and also

for the stimulation of the processes of the regeneration of peripheral neuron.

Ionogalvanization of calcium chloride it was applied for the purpose of the stimulation of regenerative processes, reduction in the painfully increased excitability in one of the cuts of peripheral neuron, and also for decrease or eliminating the trophic disorders.

With the wounds of the spine and the spinal cord, which required the use/application of ionogalvanization of the mentioned medicinal substances, the high value had a disposition of electrodes. Prof. V. K. Khoroshko recommended the following scheme.

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During the damage in the neck division longitudinal electrodes (10x4 cm) must be arranged/located on each side of spine. If damage/defeat approached thoracic vertebrae, electrodes were arranged/located as follows: one electrode to upper-neck division, and another - to the region of upper-thoracic vertebrae. During the damage of upper-thoracic and mesothoracic division of spine the electrodes were arranged/located above and below the place of damage. During the damage in lower-thoracic division of spine and I lumbar vertebra one electrode placed above places of damage, and another -

to the rump. During the damage in the region of lumbar vertebrae one electrode placed above places of damage, and as the second electrode were utilized two-chamber baths for the feet, moreover water they poured only to the bottom so that it would wash only the bottoms.

During wounds and damages of spine and spinal cord, caused development partial paralyses or paresis of the upper or lower extremities, which did not rivet; however, casualty to the bed and thereby of that had the capability to sit, were applied four-chamber baths both with the galvanic and with the faradic current. With spastic paralyses four-chamber baths contributed to the decrease of the painfully increased muscular tone.

Other forms/species of electrotherapy in this case as stable galvanization and especially rhythmic galvanization, are contrasted, since these procedures raise proprioceptive reflexes, which leads to reinforcing of spastic phenomena.

With flaccid paralyses four-chamber baths contribute to the decrease of atrophy, to an increase in the muscular tone. During the damages of horse tail which entailed paresis of the muscles of shin and feet, plating baths exert the stimulating activity on the processes of the regeneration of entire peripheral neuron.



During the utilization in this case of chamber baths for the feet during the introduction of medicinal substances, in particular, potassium iodide, chamber baths for the feet filled by water only to such height that the water of cover feet; moreover both foot baths connected by the ramified lead/duct to one pole, and the second electrode (active) with the packing, moistened by one or another medicinal substance, would lay in the form of plate on the region higher than place of damage. Under these conditions entire peripheral neuron and innervated by it damaged muscular apparatus proved to be in the sphere of influence of direct current.

With flaccid paraplegias chamber baths with the stable galvanic current it is expedient to combine with the rhythmic galvanization or the faradization, depending on that, to which form/species of current living react the nerves or muscles. The interruptions of electric current whose rhythm was regulated by metronome or usual manual electrobreaker, must not be very frequent (not more than 60 interruptions per minute), and the very performance of rhythmic electrification - by very not prolonged (10-15 minutes). For the rhythmic galvanization were utilized chamber baths, one of which is connected up the anode, and another - to the cathode. Current passed through inverter-metronome first to one, then in other direction, which contributed to the contraction/abbreviation of all muscles. Water in this case must fill baths to upper thirds of shins. The

course of treatment consisted of 20-25 procedures, after which followed the interruption from 3 to 5 weeks, then treatment again was renewed.

Electrotherapy with flaccid paralyses usually was combined with the massage and the therapeutic exercise. This complex frequently provided success.

Galvanic current was applied also during the violations of the function of the bladder both with the irretention of urine and in the case of its delay. V. K. Khoroshko was recommended the arranging/locating of electrodes during the pelvic violations as follows: with the irretention the urine one electrode place in the perineum, another - to the back, and in the case of the delay urine one of the electrodes place above the pubes, since during the imposition in this case of electrode on the perineum (action on the sphincter) could be increased the delay of urine.

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With the disorder of the functions of the bladder was applied also rhythmic faradization or rhythmic galvanization.

With the disorder of defecation was applied predominantly

rhythmic faradization by the application/appendix of smaller electrode to the anal aperture, and other (larger) - to the loin.

With paresis of intestine, together with the massage, was applied also the labile faradization (by cylinder) of the intestinal loops through the abdominal integuments, another electrode was applied motionlessly to the anal aperture.

From other forms/species of electrotherapy with the wounds of spine and spinal cord found use diathermy and UHF therapy.

Both diathermy and UHF therapy caused in contrast to the different methods of exogenous heat-treatment (radiant heat, heat-transfer agents) endogenic heat generation. In this their great advantage, since both make it possible to act on deep processes, the bone tissue not impeding the penetration of high-frequency currents and does not obstruct to them route/path for the action on the deep-lying tissues, the spinal cord, the shells.

In spite of the apparent advantages of diathermy and UHF therapy in comparison with other heat-therapeutic factors, they did not find during the years of the Great Patriotic War of more wide application than mud cure, paraffin therapy, peat treatment, etc. This was partly explained by the fact that the wounds of spine and spinal cord which

involved the irreversible changes, did not yield to the action also of these physical therapy procedures. But the processes reversed, caused either by small damage or which are localized in the anatomical divisions of spinal cord as horse tail, rootlets, shells which provided the best prospects for the reparative processes, they yielded to the therapeutic action by simpler and more available methods.

However, the effects, achieved by diathermy and in particular by UHF by therapy, must be high evaluated. In a number of cases of the wounds of spine and spinal cord with which mud cure, paraffin and ozoceritotherapy proved to be insufficient for achievement of the reabsorbing and antipyretic or soothing activity, diathermy and UHF therapy proved to be more effective, most probable, in view of their deeper action on the stricken area or deeply arranged/located damaged tissues.

High value for increasing the effectiveness of diathermy and UHF therapy had dosage and disposition of electrodes. As a general rule for the purpose of struggle with the painful syndrome were recommended the weak actions (oligothermic dosages), which did not produce considerable thermal effect. Numerous observations showed that the intense thermal actions by the factors of both exogenous heat and endogenic heat generation frequently led to the aggravation

of pains.

Had value also disposition of the electrodes: thus, for instance, longitudinal disposition of electrodes along nerve-vascular bundle rarely produced the aggravation of pains, whereas the cross disposition of electrodes, which caused the hot spot of tissues, frequently contributed to reinforcing of pains. For the same reasons to avoid the aggravations of pains applied short-time procedures in the limits of 10-20 minutes which proved to be more effective than more lasting procedures.

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With UVCh therapy attention was paid to that, so that the patient would not be placed into the high-frequency field in the presence of the long lain/rested and impregnated with pus bandage, metallic splints. In the presence of gypsum bandage it is important so that it would not be impregnated with pus. In the case of long-term gypsum bandages in them cut out itself the window, through which was produced UVCh therapy.

For the treatment of those wounded the spine and spinal cord, together with the equipment physiotherapy, in the number of hospitals and profiled scientific research institutes applied sweet, salt-coniferous and artificial hydrogen sulfide baths. They were applied both for the general/common/total action and for weakening of spastic phenomena in the extremities and eliminating painful sensations.

During the treatment of the wounds of spine and spinal cord during the years of the Great Patriotic War they widely put to use balneotherapy, predominantly on those health resorts where is

conducted treatment by the sulfuric baths (Matsesta, Pyatigorsk, Sergiyev mineral water, etc.).

Large clinical experiment/experience showed that the mineral waters, which contain free hydrogen sulfide ( $H_2S$ ), exerted favorable activity with the motor, sensitive and trophic disorders in those wounded in the spine and the spinal cord. Until now, is disputable/debatable the mechanism of the therapeutic activity of hydrogen sulfide baths, to the fact of their effectiveness during the different morbid processes it is indubitable.

As is known, hydrogen sulfide baths cause on the skin integuments the reaction of reddening whose intensity depends on the larger or smaller content in them of free hydrogen sulfide, on the temperature of water and duration of action.

Very onset of skin hyperemia, caused, as it is accepted to think, by the vasodilator activity of generatrices under the effect of stimulating activities hydrogen sulfide of histamine-like substances, it is the primary reaction, which entails the series/number of local and general/common/total processes in the organism. Together with the local action on the skin integuments, it is doubtless, occurs reflector and even resorptive activity.

Matsetsa baths K. F. Nikitin applied during the treatment of 102 patients; of them with the bullet wounds of lumbar-sacral division of spine it was 83 patients.

In the past it underwent laminectomy, 51 casualties, sequestrotomies of 19 casualties.

The full/total/complete interruption of horse tail available in 11 sick, partial interruption - in 57, the compression of horse tail - in 3, hemorrhages into the horse tail - in 25 patients.

On the remoteness of trauma the patients were distributed as follows: from 3 to 6 months - 34, from 6 months to 1 year - 36, 1 year and are more than 32 patients.

Casualties put to use the baths of three types: the sparing activity (80-100 free hydrogen sulfides, the temperature of water of 34-35°, the duration of the bath of 6-8 minutes, in a day/every other day), average/mean activity (80-100 mg of free hydrogen sulfide, temperature of water of 35-36°, duration of the bath of 10-12 minutes, 2 for in a row) and strong activity (150 mg of free hydrogen sulfide, temperature of water of 36-37°, duration of the bath of 12-15 minutes, 3 days in a row).



The results achieved are reduced to the following: considerable improvement is noted in 16 patients, improvement - in 38, small improvement - in 35, without the changes - in 3 patients and with the aggravation - in 9 - patients.

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In the same patients were established/installed some distant results of treatment by the Matsesta baths which are reduced to the following: the expressed increase in the volume of active movements and increase of muscular force in the proximal divisions of lower extremities is noted in 13 patients, moreover an improvement in the motor functions was escorted/tracked by the reduction of patellar reflexes; the reduction of reflex from cremaster - in 13 patients; vegetative-trophic disturbances continued to go to the loss/depreciation in 2 patients; bedsores healed in 5 patients, while in 12 considerably they decreased. These clinical effects were confirmed by the series/number of objective tests (oscillography, capillaroscopy, chronaximetry).

Matsesta baths exerted also the normalizing activity on the smooth musculature, the musculature of sphincters of pelvic organs/controls, improving thereby the disrupted functions of the bladder and rectum.

The bedsores little yielded to the direct effect of Matsesta

baths, which on the effectiveness were considerably inferior to the given above methods of treatment (ultraviolet lightings, paraffin-oil bandages).

Those wounded the spine and the spinal cord, with rare exceptions, transferred well Matsesta baths.

The general/common/total effect of Matsesta baths in such casualties was caused by very complex mechanism, in which, it is doubtless, main role played an improvement in the local and general/common/total blood circulation, reinforcing of regenerative processes, considerable reabsorbing and antipyretic activity.

A. A. Lavtsov gives the materials, which concern 1450 those wounded the spine and the spinal cord, that were being treated in the bags. Despite the three-four year old remoteness of morbid process, in the unit of the patients it was possible to achieve the elimination of the series/number of clinical symptoms. 15 patients of 100 "wheelchair" began to be moved on the crutches.

In Odessa treatment by salt-water baths gave positive results during different damages of spinal column and spinal cord (M. N. Neyding and L. V. Mariamova).

Numerous patients with the cerebrospinal processes were treated during the years of the Great Patriotic War in Pyatigorsk, on the Sergiyev mineral waters, in Lipetsk, in Yevpatory. Noting specific effectiveness of balneotherapy in this group of patients, O. M. Vil'chur proposes to spread readings to the direction of patients to the health resorts indicated for the purpose of more active intervention during the heavier damages and in the earlier stages of process.

The accumulated experience on the treatment of the casualties, who obtained wounds and damages of spine and spinal cord, on the Soviet health resorts came to light/detected/exposed the specific readings which covered the more tightening processes, caused by heavy contusion, hemorrhage into the shells and the spinal cord, by the partial damage of spinal cord, osteomyelitic process of spine, etc.

Large role during the years of the Great Patriotic War played therapeutic gymnastics or, wider, kinesitherapy, that encompassed, besides gymnastics, mechanotherapy, ergotherapy, massage.

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Kinesitherapy, according to V. N. Moshkov, has the following tasks: an increase in the general/common/total psychophysical tone,

an improvement in the regional blood circulation, the training session of conducting motor impulse/momentum/pulse, the removal/taking reflector-braking mechanisms, the development of skills, the reduction of the disrupted compensator motor coordination, action on different morbid conditions of the affected muscles, warning/prevention of contractures and progression of muscular atrophies, build-up/growth of paralyses of extremities, action on the spine for the purpose of the reduction of his functions as the organ/control of support and movement, the normalization of the functions of the internal organs/controls whose damage is caused by the general condition of patient and damage of spinal cord.

The therapeutic exercise was applied both with the breaks of spine without multiple failure of spinal cord and during the combined damages of spine and spinal cord, its shells and rootlets.

With the bullet wounds of spine the therapeutic exercise intends to contribute not only to the reduction of the functions whose violation was caused by the damage of spine, but also to the reinforcement of muscles both supporting the spine in the vertical position and ensuring its normal movements. Furthermore, when it was possible to reduce the mobility of spine, before the therapeutic exercise stood this task. In the therapeutic exercise was included the treatment by position/situation, which was achieved by the

correct arrangement of patient.

The general/common/total rule/handspike during the arrangement of patient with the closed damage of spine - this is the maximum discharging of spine from the need for supporting the severity of body. For this purpose to the bed they placed the thin, tightly hammered together panel, and it - separating flask. The head end of the bed is heaved on 15-30 cm, into the armpits put through the soft straps, which were fastened to the bed-head of bed. This position/situation contributed to the light stretching of spine.

Under neck lordosis and under the head they placed cushion in such a way that the neck curvature would be filled, and head was slightly deflected/diverted back/ago. Under the lumbar region they laid usually the cuneate cushion (45x25 cm) so that wide edge would come under the loin. The correctness of the arrangement of patient frequently was inspected/checked, and in the case of the restlessness/anxiety of patient or inconvenience the position/situation of patient was amended.

The organization of the rational position/situation of that wounded into the spine and the spinal cord had high value not only for reducing the functions of spine, but also in preventive sense, in the sense of struggle with the education of bedsores and the

appearance of muscular contractures as a result of the faulty positions/situations of extremities.

Prolonged position/situation with the driven away feet frequently led in the paralyzed casualties, as a result of severity and inaction of muscles, to the sagging of shins, to the distention of ligaments. For the purpose of prophylaxis under the elbows they laid cushion so that would be obtained the light flexure.

For the warning/prevention the formations of horse foot under the soles gauge stop or to entire bottom laid the wide bandage which they pulled in such a way that the foot would be held in the vertical position.

Passive and active movements began, depending on the general condition of casualty, in the first period after wound, sometimes after only 8-10 days.

The general considerations of therapeutic gymnastics for those paralyzed were reduced to the following: with spastic paralyses they attempted to lengthen and to dilate/extend muscles; the exercises, which lead to the shortening of muscles, in these cases were contrasted.

With flaccid paralyses they approached the shortening of muscles, for an increase in their contracting ability.

With full/total/complete paralysis bottom parts or upper extremities the high value had passive exercises.

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General considerations for the therapeutic exercise with the wounds of spine and spinal cord, depending on the place of damage and stage of process, are developed by V. N. Moshkov. They are reduced to the following.

With the damage/defeat of neck division in the early stage of process (from 1 1/2 months to 1 year) treatment by position/situation, the therapeutic gymnastics: exercises passive and elementary active, exercises for elongation and weakening of paretic muscular groups; exercise in the bath.

For the upper extremities: exercise in the pulsing, active and passive exercises on the contraction/abbreviation of paretic muscles with the elements/cells of burdening and on the development of the applied skills (to throw, to be sufficient, to button, to write, etc.).

For the lower extremities exercises passive and active, friendly and antifriendly, exercises to elongation and weakening of paretic muscles, exercise on all fours and on elbows. Exercises in the semi-bath, the development of support function. Initial positions lying/resting, sitting, on all fours. Simplicity of movements and their slow rate/tempo. Pauses and alternation of special exercises with general strengthening breathing exercises. To methodically force elongation with the subsequent use/application of exercises to the weakening.

For the instruction in walking were utilized the crutches, the trestles and the aid of medical personnel.

The therapeutic exercise was always applied in the complex with the massage, mudtherapy, paraffin and ozoceritotherapy, and also with the equipment physiotherapy.

Besides the local actions on area of damage/defeat and paretic muscular groups, the favorite procedure during the damages/defeats of neck division it was "collar" according to Shcherbak.

In the intermediate and last stages (duration of process is more



than year) the mentioned schemes remained the same, but only with the difference that all forms/species of action were more prolonged and more intense, if was allowed the general condition of patient.

During the damages/defeats of the mesothoracic, lower- thoracic and upper- lumbar division of spine the described above general/common/total installations of therapeutic exercises remained the same, but in essence action was directed toward the lower extremities. Greatly were used extensively exercises in the bath, the development of support functions - standing on all fours, elbows, creeping, standing with the support.

During the combination of the therapeutic exercise with different forms/species the physiotherapy, mud cure, paraffin therapy and the like frequently acted on segmental-reflector zone in the form of "belt/zone" according to Shcherbak.

During the damages/defeats of lower-lumbar and sacral division of spine to the general/common/total described above types of damages were connected also the special exercises of the muscles of pelvic belt/zone and sphincter, frequent exercises in the bath. The place of the action of physical therapy procedures (in particular, with the mud cure) was frequently selected segmental-reflector zone in the form of "belt/zone", "shorts" and "boots".

In the last stages of process the course of treatment was usually more prolonged, more intense, if to that it was not encountered contraindications from the side of the general condition of casualty.

The large contribution to the therapeutic exercise during the breaks of spine and the damages of spinal cord it introduced Ye. F. Dreving, who as early as the prewar years developed the detailed schemes of exercises, grouped in the series on with respect to the growing on difficulties of exercises.

The therapeutic exercise during the treatment of those wounded the spine greatly frequently was combined with the massage.

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Together with the favorable action on the skin integuments, the massage played very effective role in the stimulation of local roof and lymph circulations and actively influenced external muscular tension. If tension was painfully increased (for example, with spastic paralyses), it it was possible by the appropriate receptions/procedures to lower. However, with flaccid paralyses which

were usually escorted/tracked by a decrease in the muscular tone, massage raised it. Under the effect of the massage was improved the contracting function of muscles, slowed the development of muscular atrophies; if these atrophies already developed, they were decreased.

Favorable activity is exerted massage, also, with the trophic disorders, which were being frequently observed with the wounds of spinal cord. Here had value not only an improvement in the blood supply, but also the trophic impulses/moments/pulses, which develop reflector according to the type of the axon reflexes and distant reflexes.

Tests showed that the massage exerted activity under the condition for its correct use/application in the appropriate cases and employing the specific procedure. With the partial paresis the massage was applied selectively. This especially importantly in the attitude of the synergists and antagonists who always massed selectively.

The in principle different procedure of massage was applied with flaccid and spastic paralyses. Whereas with flaccid paralyses primary task of massage consisted in an increase in the muscular tone, in the second case, i.e., with spastic paralyses, they attempted by massage to lower muscular tone. To these basic tasks were subordinated

different systematic receptions/procedures.

As it was already mentioned, massage frequently was applied in combination with therapeutic exercise, ergotherapy, with different physical therapy methods. This combination of massage with other physiological agents, undoubtedly, raised its effectiveness. The parietic muscles, which lost in full or in part connection/communication with their innervational centers, lose impulses/momenta/pulses to the random and reflector contraction/abbreviation. But such muscles frequently retain the ability to react to the direct mechanical and electric stimulations. These physiological special features/peculiarities were used extensively in those wounded the spine and the spinal cord for the purpose of the combined use/application of electrogymnastics and massage.

With the muscular hyper-tone, with the muscular contractures the massage frequently was applied together with any thermo-therapeutic procedure. Heat reduced muscular excitability, decreased the skin sensitivity and contributed to reinforcing of the absorption of fission products. The order/formation of the use/application of heat therapy in the combination with the massage was determined by special readings. Massage was usually final procedure.

One of the varieties/subspecies of the combined use/application of massage with the hydropathy was above-water and underwater massage: for the first they put to use rain shower, and the second was conducted in the bath. In the latter case the bath must be large sizes/dimensions, capacity to 600-800 l of water. Because of the large sizes/dimensions of bath in it it is possible to conduct massage, and the active and passive movements of patient (kinetotherapeutic baths).

Multifeature phenomena of fallout in the motor, sensitive and trophic sphere, caused by the damage of spinal cord, yielded to the effective action of precisely combined methods of physiotherapy, therapeutic exercise, ergotherapy and massage.

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During the years of the Great Patriotic War, together with the therapeutic exercise and the massage, during the treatment of casualties extensively was used reducing of occupational therapy. Among those obtained wounds and damages of spine or spinal cord occupational therapy also was applied, but it put to use either easily casualties, without the considerable disorders of motor sphere, or in the last stages when during an improvement in the general condition of patient was improved entire clinical picture.

The principal difference between therapeutic exercise and ergotherapy consisted in the fact that for reducing the functions of occupational therapy selected not movements generally, but labor movements.

Ergotherapy tried to eliminate defects of motor apparatus by the execution of the intelligent activities which with their purposeful directionality led to the reduction of functions. These specific special features/peculiarities of occupational therapy in the relation to of both their special missions and special systematic receptions/procedures found their reflection during the years of the Great Patriotic War in those wounded in the spine and the spinal cord.

Wounded with the damage of spine and spinal cord, forced by months, and sometimes and for years to lie/rest into the bed, occupied by manual labor processes, being located in the horizontal/lying position/situation. When patients again could stand and walk, they with augmentation were occupied by labor processes in the special office for occupational therapy.

In the form of an example it is possible to give

separation/section for occupational therapy in the central institute of traumatology and orthopedics of the Ministry of Public Health of the USSR. In this separation/section were applied any forms/species ergotherapy, beginning from the thread on the tree/wood with usual knife to the work on the very complex mechanized machine tools.

From the observations it is evident that the well organized and thought-out labor exercises with respect to the motor possibilities of patient, it is doubtless, played large therapeutic role, to say nothing of that general/common/total positive psychotherapeutic action which they exerted on the patients.

Especially should be noted the value of labor exercises for reducing the disrupted coordination movements. Their value consists in the fact that these exercises give the possibility to meter and to calibrate them with respect to clinical picture and readings. However, the majority of labor processes and exercises was designed for the reduction of the motor functions of upper extremities. However, with the phenomena of fallout or violation of the motor functions of the lower extremities of the substance of ergotherapy were very limited (for example, sewing vehicles, grindstones, stamping machine tools).

More wide application obtained the methods of mechanotherapy

which completed well gaps/spacings and therapeutic physical culture, and occupational therapy. The special feature/peculiarity of mechanotherapeutic methods is the fact that they mechanically caused the exercises of the specific muscular groups, thereby contributing to overcoming contractures, preventing the trophic violations, which attack as a result of the inaction and other reasons.

With the hyper-tone of muscles, with spastic paralyses the methods of mechanotherapy are contrasted, since they contribute to reinforcing of pathologically increased tone.

The method of the therapeutic exercise, massage and mechanotherapy widely were applied during the treatment of the contractures, caused by the damage of spine and spinal cord. Contractures in this group of casualties were observed as the consequence of paralyses of separate muscles as a result of the pathologically advanced changes in the joints as a result of the prolonged and sharply pronounced painful symptom and the faulty position/situation.

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In conformity with the etiological and pathogenetic mechanisms of the onset of contractures indicated was constructed conservative



therapy.

The methods of prophylaxis had to be combined with one or the other therapeutic measures. Correct of the structure of patient, preventive massage, pain relievers and the like were used extensively for the purpose of prophylaxis of contractures. With the already formed contracture it was important to analyze the genesis of this contracture, to come to light/detect/expose the implication of one or the other muscular groups, joints, ligament-bursa apparatus, etc. Some contractures were formed as a result of the various kinds of the reflector effects which rose from both from the periphery and from the center, from the affected divisions of spinal cord.

This is why the treatment of contractures was always critical and serious and it usually occupied much time. Procedure and dosage of one or the other therapeutic substances had always high value.

In the majority of the cases of the contractures of the not very large remoteness of conservative therapy it managed if completely not to remove, then to weaken/attenuate, to decrease the limitation of movements. However, with some forms of contractures the conservative methods of treatment were powerless or unsuccessful. Here relate, for example, the contractures, connected with spastic paralyses, most frequently lower extremities, that appeared as a result of the

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involuntary spontaneous contractions/abbreviations of one or the other muscular group.

For eliminating the bending and bringing contractures in the hip, knee and talocrural joints it is not possible to put to use usual orthopedic measures as a result of exhaustion of patients, bedsores, impossibility in some cases of the arrangement of patient to the back; supplementary difficulties are created in view of the need to constantly put to use urine dump.

In these cases in N evacuation hospital S. G. Abrpn placed patients in the "cradle", which was the double strong/firm sheet, stretched between two fixed/recorded to the bed longitudinal rods. To these rods in the foot and nose section fasten the columns with the longitudinal parallels and the pulley tackle. Patient is placed in such a way that it concerns sheet only by back. Thighs, crus and feet suspend in the position/situation of that strain in which they are located, on special hammocks with the appropriate cargoes whose severity they gradually increase. According to S. G. Abrin's data, by this method it was possible to remove contractures during several days.

The multifeature motor violations, caused by the damage of spine or spinal cord and which appear it is primary or for a second time,

served as object the actions of the different types of physiotherapy, therapeutic exercise and ergotherapy. The wide selection of these actions and the great possibilities to vary different methods during treatment of one and the same patient created certain danger of the overload of the patient with procedures with all resultant harmful consequences. In view of this all types of conservative therapy must were it is conducted through the specific plan/layout, on the specific scheme, based not only on the clinical picture, the general condition of patient, but also on the physical characteristic of those factors which it was proposed to apply. Furthermore, had a value and the stages of the development of morbid process - initial, intermediate, late, which were characterized by the fact or another symptom-complex, which were being characterized by specific dynamicity.

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It is very important to emphasize the reactivity of patient to these or other the actions, which are general/common/total response reaction for the use/application of external irritants. The character/nature of this reaction was determined first of all by the general condition of patient and by the special features/peculiarities of clinical picture. In a sizable quantity of cases on the reactivity of patient depended the selection of the

method of treatment, procedure and dosage. Other cases were necessary to reject the very effective method of treatment, but caused the unfavorable local and general/common/total reactions of organism. In view of the same considerations established/installed and the specific periods of treatment, free gaps/intervals, changeover from one method the treatments in another, etc.

Thus, during the treatment of casualties with the damage of spine and spinal cord it was necessary to strictly observe the principle of the deeply thought-out individualization of the treatment of patient.

The issues of the treatment of the military traumata of spine and spinal cord by the methods only of conservative therapy cannot be represented separately, in view of the fact that in the majority of the cases was applied complex treatment by surgical and conservative methods.

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Special unit.

Chapter I.

Nonpenetrating wounds of spine <sup>1</sup>.

FOOTNOTE <sup>1</sup>. In present chapter are described paravertebral wounds (damage of the contained spinal canal without the damage of spine) as having much similar in the clinical manifestations and united under the general/common/total for both groups principles of treatment.  
ENDFOOTNOTE.

According to the data of the development of the histories of disease/sickness/illness/malady, the nonpenetrating wounds of spine (including paravertebral ones) composed 43.80/o of all bullet damages of spine.

Mechanisms of the damage of spinal cord and its rootlets with the nonpenetrating wounds of spine.

Corresponding member of academy of medical sciences of the USSR the

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distinguished worker of the tossing of professor I. Ya. Razdol'skiy.

During the first world the soldiers were assumed the following types of the mechanism of the damages of spinal cord and its rootlets with the nonpenetrating and paravertebral wounds: 1) the sharp jolt of spinal cord as a result of the transfer for it of kinetic energy of the wounding shell through the vertebra or rib and vertebra at the moment of colliding with them the wounding shell, 2) the straight/direct contusion of spinal cord or contusion from shock/counterblow against the walls of spinal canal as a result of the displacement to the instant of vertebra or bending inward of its small arc under the activity of the wounding shell, 3) sharp variations of the pressure of cerebro-spinal fluid under the effect of the same factors, 4) jolt or damage of spinal cord as a result of the contusion of spine against the soil with the incidence/drop in the casualty following by wound, 5) the sharp reflector disorders of the vascular innervation of spinal cord, which lead to the onset in it of ischemic necroses and hemorrhagic foci.

The experiment/experience of Great Patriotic War gave extensive material for inspecting/checking some of the given points of view. As that least substantiated it is necessary to consider the point of view of Warburg and Ranzi (Marburg and Ranzi) about the role of the contusion of spine against the soil (in connection with the

incidence/drop in the casualty after wound) in pathogenesis of the damages of spinal cord. From the detailed inquiry by the author of casualties with the bullet damages of spine about the position/situation which they occupied at the moment of wound, she was explained that very many of them, including with the proved nonpenetrating wounds, at the moment of wound were located in the horizontal/lying or halfbent position/situation. Consequently not about what supplementary contusion of spine against the soil in connection with the incidence/drop it could be and speech.

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The point of view of Marburg and Ranzi contradicts the fact that with wounded in skull, plotted/applied at the moment of the determination of casualty in the vertical or semivertical position/situation and, therefore, which were being escorted/tracked by the sudden loss of consciousness and by the incidence/drop, the associated damage of spinal cord was observed exclusively rarely. In the same cases, when the bullet trauma of spinal column was escorted/tracked by the incidence/drop from the height or the deletion of wounded by air wave during the explosion large/coarse artillery shell or aircraft bomb, there was possibly the supplementary damage of spinal cord in connection with the contusion of spine; but then it should be considered as the result of the closed trauma of spinal cord, which did not have direct connection/communication with the wound.

Indisputably important role in the damage of spinal cord and its rootlets with the nonpenetrating wounds belonged to jolt or displacement of vertebra, caused by the wounding shell, and also instantaneous to the bending inward of small arc under the activity of the latter. In favor of the value of these mechanisms speaks the direct dependence between the direction and the angle at which the shell struck into the spine, and by the severity of the damages of spinal cord in this case. Than nearer to the center line of body and the greater the angle at which the shell hit into the spine, it approached straight line, the more damage deposited it on brain. Thus, if shell ran into the body of vertebra in the sagittal or close to it plane, besides at the right angle to the axis of spine, the damage, inflicted by them to spinal cord, was usually heavier than when it ran into the spine at sharp angle, besides not in the sagittal plane.

In the first case entire/all kinetic energy of the wounding shell is spent on the displacement of vertebra, and in the second case - only unit. In accordance with this with the identical supply of kinetic energy the wounding shell, acting through the vertebra, spends in the first case the considerably large part of its force to the damage of spinal cord, than the secondly.

The value of angle and projection of the movement of the



wounding shell with respect to the middle sagittal plane of body for depositing the damage to spinal cord is especially is distinctly evident based on the examples of the wound of cross and awned extensions.

If with bullet moved more or less in parallel to spinal column, then it could destroy 1-2 or more cross extensions, without having applied to the spinal cord of how much essential damage. Repeatedly were described the cases of the bullet break of the cross extensions of several vertebrae (2-3 and more), moreover occurred only the insignificant jolt of spinal cord, being subjected to reverse development during 1-1 1/2 weeks. On the contrary, if the wounding shell broke cross extension, running not it in the frontal plane and at the right angle to the spine, then, having available the same supply of kinetic energy, it damaged spinal cord considerably more strong.

Equally the wounding shell much more strongly damaged spinal cord, also, in such a case when it was hit into the awned extension, running into it in the sagittal plane and under more or less right angle to length of spine, than when it, moving in the same of plane, slipped on the awned extensions, breaking them on its route/path.

In the first case the wounding shell often deposited the very serious damage to spinal cord, bending in to the instant small arc into the lumen of spinal canal; in the second case it usually deposited on it insignificant damage, since the lateral activity of the wounding shell is insufficient for the bending inward handle and for the contusion of the spinal cord through its means.

In the literature it was repeatedly underscored that the parallelism between the degree of the damage of spine and the severity of the damage of spinal cord frequently is absent. This absence of parallelism in each individual case of the wound of spine can be understood only upon consideration of the angle at which the shell ran into the spine, and the plane, in which it moved.

As further confirmation of the value of mechanical factor in the deposition of damage the spinal cord (instantaneous displacement of vertebra, bending inward of small arc) serves the fact that the foci in it appeared not only in the division, which corresponds to the place of application of the activity of the wounding shell (straight/direct damage), but frequently and in the diametrically opposite direction, on shock/counterblow.

Together with the damage of spinal cord by the transfer to it of kinetic energy of the wounding shell through body or small arc of vertebra, the significant role in the pathogenesis of the cerebrospinal and root violations belong also to disorders of blood circulation. The latter could have purely reflector character/nature or appear as a result of the wound of large/coarse root arteries. The surprise sharp stimulation of posterior rootlets and intervertebral ganglia/nodes by the wounding shell could cause strong angiospasm, in particular, the front/leading artery of spinal cord (a medullae spinalis anterior) and lead to the appearance of ischemic foci in the spinal cord both on the level of the damage of spine and in its distant sectors.

On the basis of the experiment/experience of the Great Patriotic War M. S. Margulis especially persistently underscored the value of nerve-vascular factor in pathogenesis of the bullet damages/defects of spinal cord with the nonpenetrating wounds of spine. The role of this factor is especially great in pathogenesis of fine/small hemorrhages and necrotic foci, which appeared far from the place of the straight/direct action of the wounding shell on the spine.

With the wounds of edges/fins near their fastening to the vertebrae, and also with wounding of the bones of shoulder and pelvic belt/zone the damage of spinal cord or its rootlets appeared as a

result of the transmission on them of the jolt of vertebrae, appeared at the moment/torque collision of the wounding shell with the mentioned bone education.

With the paravertebral wounds, which caused damage of rootlets of the brachial and lumbar-sacral plexus, spinal cord it was damaged as a result of the surprise and sharp tension of rootlets. Pathomorphological changes in these cases were evinced by the appearance of fine/small hemorrhages and necrotic foci in the zone of the entrance of rootlets into the spinal cord and in its adjacent it sectors.

The wounding shell, together with the described higher roughly mechanical linkage by the spinal cord of its kinetic energy through the vertebra, deposited on it damage, causing at the moment of collision with the vertebra the with lightning speed rapid exchange of increase and lowering in the pressure of cerebro-spinal fluid.

This hydrodynamically activity of cerebro-spinal fluid could be very considerable and cause changes in the spinal cord and its rootlets at a great distance from the basic stricken area.

However, the traumatizing action of this factor had incomparably larger value with the penetrating wounds of spinal column, why its

mechanism will be examined in the following chapter.

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More than in the half the cases of the nonpenetrating and paravertebral wounds of spine neurological violations were expressed weakly and they rapidly underwent reverse development. In view of the weak manifestation of neurological violations the majority of casualties with the nonpenetrating and paravertebral wounds was located undergoing medical treatment in the general-surgical evacuation hospitals. On the contrary, the heavy forms of the damage/defeat of spinal cord with these wounds were observed rarely. Thus, the syndrome of the full/total/complete violation of the conductivity of spinal cord was noted altogether only into 4.50/o (with those penetrating - into 46.90/o). Most frequently it was observed with the wounds of the thoracic division of spine; most rarely - with the wounds of lumbar-sacral division it related only to the cone and epicone (Table 22).

The clinical forms of the damage/defeat of spinal cord with the nonpenetrating and paravertebral wounds were multifeature. They rarely were isolated, whereas more frequent they were encountered in different combinations.

Frequency of the clinical forms of the damage/defeat of spinal cord with the nonpenetrating (and paravertebral) wounds of spine based on materials of the personal observations of I. Ya. Razdol'skiy (GBF) .

(1) Клинические формы поражения спинного мозга	(2) Процент
(3) Без неврологических нарушений . . . . .	6.2
(4) Радиккулит и менинго-радиккулит . . . . .	7.6
(5) Сотрясение спинного мозга . . . . .	13.0
(6) Отек спинного мозга . . . . .	2.9
(7) Субарахноидальное кровоизлияние . . . . .	2.0
(8) Гематома . . . . .	3.1
(9) Гемatomyelia (трубчатая) . . . . .	1.6
(10) Ушиб спинного мозга . . . . .	43.5
(11) Ушиб и сотрясение конского хвоста . . . . .	20.1
	<hr/> 100.0

Key: (1). Clinical forms of the damage/defeat of spinal cord. (2). Percentage. (3). Without neurological violations. (4). Radiculitis and meningo-radiculitis. (5). Jolt of spinal cord. (6). Edema of spinal cord. (7). Sub-arachnoidal hemorrhage. (8). Hematoma. (9). Hematomyelia (tubular). (10). Contusion of spinal cord. (11). Contusion and jolt of horse tail.

From the preceding information it is evident that most frequently with paravertebral and nonpenetrating wounds were observed the contusions and concussions of spinal cord and horse tail.

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Table 22. Frequency and severity of neurologic violations with the paravertebral ones and with the nonpenetrating wounds of spine (in the percentages).

(1) Тяжесть неврологиче- ских нарушений	(2) Отдел позвоночника	(3) Все отделы	(4) Шейный	(5) Грудной	(6) Поло- вично- крестно- вый
(7) Неврологические нарушения отсутство- вали или быстро проходили . . . . .		62,3	63,8	55,9	65,2
(8) Синдром полного нарушения проводимо- сти спинного мозга . . . . .		4,5	3,3	8,6	1,5
(9) Синдром частичного нарушения проводимости спинного мозга . . . . .		27,2	30,9	33,3	17,3
(10) Повреждение конского хвоста . . . . .		6,0	—	2,2	10,0
		100,0	100,0	100,0	100,0

Key: (1). Severity of neurological disturbances. (2). Division of spine. (3). All divisions. (4). Cervical. (5). Thoracic. (6). Lumbosacral. (7). Neurologic violations were absent or rapidly they passed. (8). Syndrome of full/total/complete violation of conductivity of spinal cord. (9). Syndrome of partial violation of conductivity of spinal cord. (10). Damage of horse tail.

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Concussion of the spinal cord.

Concussion of spinal cord with nonpenetrating wounds of spine was observed comparatively frequently (into 13.00/o). Most frequently it was noted with contusions and wounds of awned and cross extensions and bodies of vertebrae.

The loss of consciousness was observed rarely, besides only with the wounds of the neck division of spine or under the simultaneous influence on the casualty of strong blast.

Pains, as a rule, were absent. Exception were those cases when simultaneously were destroyed rootlets. In the paretic extremities casualties usually tested/experienced the various kinds of paresthesia in the form of numbness, creeping of goose pimples, tinglings. Deep and surface reflexes were weakened, thinner/less frequent to the short period they were lost. Frequently were observed bradycardia, moderate hypothermia. In the heavy cases of the jolt of lumbar-sacral thickening rarely was observed fine delay of urine. The development of bedsores was not noted. Spinal cord fluid/liquid usually was not changed, but its pressure in the half the cases was moderately increased.

In the mild cases all phenomena disappeared for several days; in the heavier after 2-3 days appeared only the first symptoms of improvement, and the full/total/complete reduction of motor, sensitive and reflector violations attacked/advanced only through 2-3 weeks. Sometimes the organic micro-symptoms and the light weakness of the sphincter of the bladder, which changes the original delay of



urine, were held during the more prolonged period. These cases stand on the face of the light contusions of spinal cord.

The diagnosis of the heavy forms of the jolt of spinal cord during the first hours and even days after wound always can be placed with the confidence. Sometimes these cases at first of considering as the contusion of spinal cord, but the rapid reduction of the initially disrupted functions inclined doctors, who observed of a similar genus of casualties, to the diagnosis not of the contusion of spinal cord, but jolt.

With the jolts of spinal cord, having finished with the fatal result as a result of the associated wound of any internal organ/control, in the spinal cord either they found no macroscopic changes, or they consisted of light edema of spinal cord and its soft shells, of the separate fine/small localized hemorrhages into the substance of spinal cord. Sometimes found the smallest necrotic foci.

Treatment. Basic treatment consisted of the rest. By casualties, if they even could get up, it should have been abstained from this to the complete disappearance of weakness in the lower extremities. A number of the authors applied the cholinergic substances (proserin, eserine), which exerted especially favorable activity on the disorders of urination. Motor violations with the jolts of spinal

cord under their effect were reduced also noticeably more rapid.

Possibility and speed of the return to the numbers of the army of those transferred the jolt of spinal cord on the soil of the bullet wounds of spine depended on severity and character/nature of the wound of the latter. In the wounds, which were not being escorted/tracked by the essential damage of spine or internal organs/controls, the casualties returned to the unit on the healing of wound, but not are earlier than 1 1/2 - 2 months from the moment/torque of wound.

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Edema of the spinal cord.

Tissue of spinal cord, especially brain, especially white substance, easily reacts to the damage by edema. The undamaged/uninjured soft cerebral shell impedes the spread of edema in the transverse direction; therefore it is spread mainly upward and downward from the place of damage. As the phenomenon, which associates the heavy bullet damage of spinal cord, edema was observed very frequently. But in these cases the symptoms, called by it, usually weakly came forward in the clinical picture due to the overlap by their symptoms of basic focus. Sometimes it swelled it appeared against the background of a comparatively weak damage/defeat of spinal cord, and then it acquired the independent value.

In clinical sense for reactive edema of spinal cord is characteristic the absence of pains and the fact that the maximum of functional fallouts appeared not immediately after wound, but through several hours or during the next 2-3 days. Sometimes phenomena began to grow on after temporary/time improvement, for example, upon the connection of edema to the jolt of spinal cord. The latter fact drew together the clinical manifestations of edema and epidural hematoma. The increase of edema was frequently conditioned on physical stress of the casualty, for example, walking.

As a typical example can serve the following observation.

K-a obtained 27/VI 1943 the tangential bullet nonpenetrating wound of spine with the break of awned process of the VI thoracic vertebra. Immediately after wound "were taken away feet and was numb the lower unit of the body" after 40-50 minutes appeared the first movements, and after 2 hours casualty already could sufficiently freely be moved. 3 Hours after wound with the aid of soldier-sanntara it was guided on PMP. In proportion to advance the weakness in the feet and the perception of numbness in them again began to grow on, and, when casualty passed approximately/exemplarily 0.75 km, "feet completely were taken away". During the neurologic investigation (3

days after wound) is established/installed a deep flaccid paresis of lower extremities with a decrease in the skin sensitivity from the sixth thoracic segment; flaccid knee and achylia reflexes, sharply difficult urination. Small pains in the region of wound. the paresis of lower extremities was held during 1 1/2 months.

In the heavy cases edema of spinal cord caused a deep cross violation of its conductivity. Since edema, especially if it accompanied the contusion of spinal cord, detected the tendency to be spread predominantly in the vertical direction on the average to 2-3, and sometimes also more than segments, then, together with gradual reinforcing of conductor violations, appeared new disorders due to the implication in the suffering of those lying above and below the divisions of spinal cord.

The progression of edema in the vertical direction was especially dangerous with contusions and wounds of the neck division of spinal cord. Being spread upward, it paralyzed the nuclei/kernels of stomach nerves or even respiratory center in the medulla oblongata. To this danger of progressive reactive edema during the bullet damages/defeats of the neck division of spinal cord was turned the attention even in the first world war; it was confirmed by the observations of many Soviet surgeons and neuropathologists, also, in the Great Patriotic War.

Edema seemingly strangled nerve elements/cells. Long existing edema caused in them the irreversible changes. In extra-heavy cases the matter reached the edematic melting of the tissue of spinal cord (L. I. Smirnov).

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With the pathoanatomical autopsy of the killed from the associated damages internal organs/controls in certain cases they detected that the strongly edematic brain caused the blockade of sub-arachnoidal space.

In the cerebro-spinal fluid rarely were noted an insignificant increase in the number of cellular elements/cells, frequent-moderate pressure increase. Edema usually was held 1-1 1/2 weeks.

In the later periods severe edema of spinal cord captured sometimes its extensive divisions. In these periods it appeared on the soil of the intoxication of spinal cord, which proceeded from the urination system or the bedsores.

Edema of spinal cord most frequently it was necessary to differentiate with hematomyelia and hematoma. From hematomyelia edema differs in terms of the conductor character/nature of the violation of sensitivity, while from hematoma - by absence of pains.

Treatment was reduced to rest, dehydration by the introduction of hypertonic solutions to vein. Some authors applied repeated lumbar punctures, but their use was doubtful.

#### Hematomyelia.

The massive, more or less isolated/insulated hemorrhages into the gray substance of spinal cord (tubular hematomyelia) during the bullet damages/defeats were observed rarely; according to the observations of I. Ya. Razdol'skiy, they composed 1.60/o of all nonpenetrating wounds of spine.

On the contrary, impregnation by the blood by the blood of contusion focus and nearest to it sectors of gray and white substance was encountered frequently. N. I. Grashchenkov and M. S. Margulis this type of cases of impregnation by the blood of contusion foci considered as hematomyelia. Ye. I. Tarakanov on the basis of this expanded interpretation of the term "hematomyelia", asserted that it was observed by it into 40.00/o of all bullet wounds of spine, which were being escorted/tracked by the damage/defeat of spinal cord.

However, the so/such expanded interpretation of term hardly is expedient. First, because it is made by unclear, however, that should be called the contusion of the spinal cord, in the second place,

hematomyelia as clinical form loses its individuality, since its basic symptom - dissociated violation of sensitivity as a result of the simultaneous implication in the suffering of white substance - it drops out and diagnosis becomes impossible.

That set forth relates below to the typical (tubular) form of hematomyelia whose symptoms in the clinical picture of the damage/lesion of spinal cord came forward to the foreground. It is very probable that some cases of hematomyelia with the bullet wounds of spine were obliged by their onset to the strong contusion of spine against the earth/ground in connection with the deletion of the casualty by air wave, for example, during the explosion at the close distance of artillery shell, large/coarse mine, aircraft bomb whose fragments deposited wound.

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During the usual closed closed damages of spine and spinal cord hematomylas most frequently they appeared in the region of neck thickening. A. I. Geymanovich explains this to those that with the incidence/drop on the back maximally was contused the VII neck vertebra as a result of strong projection of his arched extension. With the bullet wounds of the spine hematomyelia it was observed in all divisions of spinal cord, but nevertheless in the region of



thickenings it was observed more frequently and it had larger/coarser sizes/dimensions. Basic hematomyelitic focus usually corresponded to the place of the straight/direct action of the wounding shell on the spine. Hence it was spread upward and downward for the elongation/extent of 2-3 segments. Sometimes hematomyelia it captured to 10 even more than segments.

In clinical sense for hematomyelia, as is known, the typically progressive build-up/growth of phenomena (for a period of 2-3 hours, thinner/less frequent more) and more or less distinctly expressed dissociated character/nature of the disorder of sensitivity, i.e., the loss of painful and temperature sensitivity with the state of preservation of tactile and musculoarticular. But when hematomyelia it was connected up the heavy damage of spinal cord, its typical symptoms were frequently shaded by the additional foci of damage above and below basic, and also by reactive edema. In this type of cases, especially in the sharp/acute stage, hematomyelia usually it was not distinguished. The weaker there was the damage of the white substance of spinal cord, the more distinctly was deployed the clinical picture of hematomyelia.

Especially distinctly was deployed the clinical picture of hematomyelia when more or less massive hemorrhage appeared through several hours or days after wound, i.e., already after the begun

reduction of functional fallouts. The reason for these late spinal apoplexies were the gaps of the vessels, torn slightly at the moment of depositing the trauma to spinal cord, in connection with physical stress, strong cough, sneezing/popping, etc. The cases of this genus in the presence of the closed trauma of spinal cord were described repeatedly. With the bullet wounds of spine they were observed exclusively rarely.

As an example can serve the following observation.

P on 27/IV 1944 obtained the wound of lumbar region by fragment with the break of the awned extension of the XII thoracic vertebra. Immediately after wound arose paralysis of lower extremities and delay of urine. Urination was reduced through 3 weeks, movements in the feet - in 3 months. Remained light paretic phenomena in the feet. During the physical culture exercises at the moment of strong physical stress/voltage suddenly developed paralysis of feet, delay of urine and feces. Patient it perished in 1 1/2 months from the sepsis on the soil of extensive bedsores. Autopsy revealed/detected the almost complete destruction of the gray substance of cone and epicone on the soil of hemorrhage into the gray substance of this division of spinal cord.

with hematomyelias, which appeared on the soil more rough

damages of spinal cord, the violations of sensitivity had the mixed character/nature. From the level of primary traumatic focus they carried conductor character/nature, and upwards from it for the greater or smaller elongation/extent - dissociated. This special feature/peculiarity of hematomyelia of traumatic origin especially underscored L. S. Minor. In the divisions, innervated by the segments where it developed hematomyelia, paresis and paralysis they had flaccid character/nature, with the lost or weakened reflexes and with the subsequent atrophy of muscles. Paresis and paralyzes of those lying of below the divisions of body at first in connection with the cerebrospinal shock had flaccid character/nature, being changed subsequently by spastic ones.

With the localization of hematomyelia in lumbar-sacral thickening early appeared the bedsores. The disorders of the function of pelvic organs/controls during the damages/defects of this thickening were frequent and firm. With the high localizations of hematomyelitic focus the original delay of urine was comparatively rapidly changed by the automatic emptying of the bladder. Pains usually were absent, and even if they occurred, then rarely they had any considerable character/nature.

On the contrary, paresthesias at the moment of the compression of gray substance by the issuing itself blood were observed frequently. They were expressed in the perceptions of the growing numbness, pressure, heat, tingling, creeping goose pimples, etc.

In differential-diagnostic sense hematomyelitis differs from edema of brain in terms of the presence with it of the dissociated violation of sensitivity, and from hematoma - by absence of radicular pains.

On the autopsies of those been killed within the early periods after wound or with laminectomy in these periods the spinal cord at the level of hematomyelitis was thickened, as if inflated. Sometimes it would have been possible to determine fluctuation. With the autopsy of those been killed within the late periods on the spot for available hematomyelitis is found the area, filled with the dense xanthochromium fluid/liquid, which contains a large quantity of protein. In the walls of area usually were detected the deposits of hemosiderin. These deposits, and also xanthochromium stain/staining of fluid/liquid differed posthematomyelitic areas from the appearing as a result of resorption ischemic and contusion foci.

Was voiced the opinion that the posthematomyelitic areas can progressively be increased, i.e., overgrow into the similarity of

syringomyelia. This type of overgrowing of hematomyelia into syringomyelia in casualties in the Great Patriotic War was not observed.

In proportion to the resorption of the blood the conductor violations, caused by the pressure of the blood on the white substance, gradually underwent considerable reverse development. An improvement in the segmental disorders also occurred, but it rarely was essential.

Hematomyelia itself, with exception of the cases of its localization in the neck division of brain, direct threat life did not present. But in the heavy cases casualties perished from the common for the bullet wounds of spinal cord complications. Hematomyelia of upper-neck division of spinal cord are very risky: were observed the cases of the death of casualties from asphyxia as a result of paralysis of the thoraco-ventricular nerves.

The recognition of hematomyelia on the soil of the bullet damages/defeats of spine and spinal cord in the early period ran into the great difficulties. When hematomyelia accompanied the more diffuse damage/defeat of spinal cord or had comparatively small extent in the vertical direction, it, especially in the sharp/acute and early period, usually was not distinguished.

The most characteristic symptom of isolated/insulated hematomyelia is, as is known, the build-up/growth of functional fallouts on the time, in particular, in the vertical direction. This build-up/growth was especially conclusive, if it attacked/advanced after the outlined improvement. But this symptom is characteristic not only for hematomyelia, but also for progressive reactive edema of brain, or for epidural hematoma. Difference consists in the fact that with hematomyelia the disorder of sensitivity had the dissociated character/nature, and with reactive edema and epidural hematoma - conductor. The blockade of the sub-arachnoidal space of spinal cord was not noted not into one case of hematomyelia where was applied lumbar puncture.

The diagnosis of late hematomyelia did not present difficulties. The surprise development of spinal phenomena in of the transferred the bullet trauma spinal cord, progressive their build-up/growth for a certain period of time and dissociated character/nature the violations of sensitivity provided recognition.

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Treatment. With the suspicion to hematomyelia was applied a

strict bed mode/conditions during the next 3-4 weeks. During the first days one should have observed large care with the transfer of casualty, with the exchange of bandage, the emptying of intestine. Inside assigned the substances, which raise the coagulability of the blood (ascorbic acid, gelatin, calcium chloride, etc.).

In other respects the organization of departure/attendance and treatment the same as with any heavy bullet wound of spinal cord.

In the prewar time repeatedly was raised the question about the surgical treatment of hematomyelia, first of all of spontaneous, and also on the soil of the dull traumata of spine. With hematomyelia on the soil of the bullet damages/defects of spine in the Great Patriotic War the majority of the neuropathologists and surgeons solved this problem negatively. In the published work of the Soviet surgeons during the period the wars and in the materials of the development of the histories of the disease/sickness/illness/malady of indication of surgical interventions apropos of hematomyelia are absent.

Hematomas. Epidural, is subdural.

The outflows of the blood into the epidural, the subdural and especially into the sub-arachnoidal space with the nonpenetrating

wounds of spine were observed comparatively frequently. But massive hemorrhages into these spaces, which caused the compression of spinal cord in spite of the assertions of some foreign authors (Krause, Borst, etc.) were observed rarely (according to the personal observations of the author into 3.10/o).

Massive hematomas, which squeezed spinal cord, in the epidural space were observed more frequently than in the subdural or the sub-arachnoidal.

During the damages/defeats of the neck and lumbar division of spine they were noted more frequent than during the damages/defeats of its thoracic division. Is explained this, apparently by the fact that in these divisions of spine the venous net/system is developed especially strongly and therefore hemorrhage is more abundant.

Based on materials of the observations of a number of the authors in the Great Patriotic War, the spinal cord at the level of localization of hematoma was not is only it was compressed, but also it was softened. The full/total/complete blockade of the sub-arachnoidal space of hematoma was produced rarely.

Itself hematoma does not present the direct threat of the life of casualty. Exception are epidural hematomas, which are localized in



the neck division. In view of the threat of asphyxia these hematomas, as in the first world war, they were considered shown for urgent surgical intervention.

I-n obtained 27/IV 1942 the perforating bullet nonpenetrating wound of spine at the level of the VII neck vertebra.

Immediately after wound the short-time loss of consciousness. After arriving into itself, noted the incapacity to move hands and almost full/total/complete paralysis of feet. After 1 1/2 hours of movement in the feet noticeably they were improved. The first light movements in the hands appeared after 2-3 hours. Simultaneously appeared pains in the neck and the hands and difficulty during the movement by head. In view of the nearness of front to the hospital basis during the same day, passing the series/number of stages, it was delivered into the hospital. Upon the neurologic examination/inspection 28/IV the general condition is heavy. Severe pains in neck-postcranial region and in the hands. Sharp postcranial muscle tension. Respiration is extremely hindered/hampered.

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Paralysis of all four extremities; the gross violation of all forms/species of sensitivity from the level of the fourth neck

segment, the delay of the urine (on the eve, although with certain difficulty, it was wet independently). Hypothermia ( $34.2^{\circ}$ ), pulse of 42 shocks per minute, weak fillings. In view of the extremely heavy condition of casualty X-ray examination was not conducted. Casualty was undertaken the operating table with the assumed diagnosis: penetrating wound of spine, epidural hematoma.

Laminectomy. "... The averted extension of the VII neck vertebra is broken in basis and is displaced somewhat to the left. Small arc of this vertebra without the visible damages. After the removal/distance of arcs of the VI-VII neck and I thoracic vertebra in the epidural space is discovered the considerable accumulation of the blood, which was partially rolled up. After the removal/distance of the blood in the limits of operating field it is evident that its accumulation is continued and above. Is additionally removed small arc of the V neck vertebra at the level of which is also discovered and removed considerable sizes/dimensions the cluster ...". Already on the operating table respiration became more freely, and the general condition was improved. Next day appeared the light movements of lower extremities. Independent urination was reduced on the 3rd day; the first movements of upper extremities appeared after 7 days. Through 3 1/2 weeks of patient although with difficulty, already it could independently be moved, and the movements of upper extremities so were improved that it could hold down/retain spoon.

The spread of hematoma in the vertical direction can be considerable. were observed the cases of its dissemination on entire epidural space - from the rump to the postcranial hole.

With the bullet wounds of spinal cord hematoma rarely was observed isolated/insulated, usually it accompanied the more or less heavy damage of spinal cord. If in these cases hematoma was not extended upward beyond the limits of basic focus, it little added to the already available symptoms of the damage of spinal cord or horse tail and usually it was not distinguished.

The most typical symptoms of epidural hematoma were radicular pains and paresthesias. Since the compression of rootlets, necessary for the onset of pains, attacked/advanced only after the considerable accumulation of the blood, then pains appeared not immediately after wound, but later several hours. The weaker was damaged the spinal cord or the rootlets of horse tail, the more intense there were these pains. Sometimes pains in the development period of hematoma were absent or they were expressed weakly and were amplified or for the first time appeared only in the period its resorptions as a result of the compression of rootlets by the blood clots, which were undergoing organization.

The second characteristic feature of hematomas was the consecutive dissemination of radicular pains to the new regions of body. It was conditioned on the gradual spread of hematoma from the place of origin on the epidural space. Frequently was noted the sharp reflector muscle tension, which simulated the picture of acute spinal meningitis.

With hematoma, which develops against the background of the rough cross damage of spinal cord, radicular pains appeared only in such a case when it heaved above focus and squeezed the rootlets, which enter into the spinal cord proximally from it. If hematoma during the progressive dissemination squeezed spinal cord, then radicular pains down from this place disappeared, and above they continued to be retained.

Lumbar puncture with epidural hematomas was applied rarely. But when it was conducted, cerebro-spinal fluid did not usually present substantial changes. But if simultaneously heavily was damaged spinal cord, then changes in the cerebro-spinal fluid were completely determined by the character/nature of its damage. In the later periods in the cerebro-spinal fluid frequently was observed the syndrome of protein-cellular dissociation.

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Fig. 84. Bullet wound of lower division of spinal cord and unit of

horse tail. Blood clots and suppurative impositions on the internal surface of solid cerebral shell and cloudiness of soft.

Preparation VMM No 2662. (Artist T. V. Belyayeva).

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In the typical cases the recognition of epidural hematoma did not present difficulties. Diagnosis set on the basis of the onset of radicular pains and symptoms of the compression of spinal cord later several hours or within the next few days after wound (frequently after transportation and physical stress of casualty) and gradual increase both their intensity and region disseminations. To differentiate it was necessary with reactive edema of brain, sub-arachnoidal hemorrhage and sharp/acute suppurative pachymeningitis. With reactive edema the pains are absent, while during the sub-arachnoidal hemorrhage cerebro-spinal fluid is blood-containing.

In the cases of late hematomas, which appear to the 3-5th day it is later, it is very difficult it was difficult to differentiate them from the early forms of sharp/acute suppurative pachymeningitis. The experiment/experience of the Great Patriotic War showed that in this respect it is important to have in mind the following: the early

forms of suppurative pachymeningitis were observed mainly with the penetrating wounds of spine and were escorted/tracked by an increase in the temperature. But hematomas, as noted above, more frequently appeared with the nonpenetrating wounds of spine; an increase in the temperature at them was absent. But in the cases of festering hematoma this differential sign lost its value.

The issuing from blood, as showed autopsies, was gradually resolved, but the remaining blood clots, germinated by connective elements/cells, contributed to the development of epidural ones Rubtsov, subsequently of those compressing rootlets, vessels and spinal cord. Sometimes hematomas rotted and were the source of the development of heavy suppurative pachymeningitis and leptomeningites. As illustration to that presented can serve the case of the nonpenetrating bullet wound of the lower division of spine (Fig. 84).

Treatment. On the basis of the experiment/experience of the first world war authors' majority considered the surgical treatment of hematoma excessive, and some, in view of the light infection of the uneliminated/unremoved remainders/residues by their, and risky. Exclusion was allowed/assumed only for hematomas of the neck division of spinal cord, especially with the suspicion to their onset from the spinal artery. Only a few assumed that massive hematomas, which compress spinal cord, are subject to removal/distance independent of

their localization.

In the Great Patriotic War this question, in connection with the dominated opinion about the need for the early radical processing of wound, to a considerable degree lost its sharpness.

During the detection of hematoma during surgical interventions on other occasions the surgeons attempted, for the purpose of prophylaxis of the subsequent suppurative complications and severe epidurites, to drive out it completely.

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Hemorrhage into a sub-arachnoidal space.

The more or less isolated/insulated and considerable sub-arachnoidal hemorrhages in the sharp/acute and early period were observed rarely (according to the personal observations of the author - into 2.00/3). Judging according to the data of the pathomorphological autopsies of those been killed, the issuing from blood was spread on the sub-arachnoidal space as upward (that N. N. Burdenko demonstrated experimentally), so mainly downward, into the region of horse tail. Generating here between the rootlets of horse tail blood clots squeezed the latter and were jerk/impulse to the



development of the heavy forms of arachnoiditis. V. K. Khoroshko counted this secondary arachnoiditis of horse tail on the soil of occurred sub-arachnoidal hemorrhage of one of the reasons for the frequent combination of the elements/cells of flaccid and spastic paralysis during the damage of spinal cord for higher than the lumbar-sacral thickening.

The basic symptoms of sub-arachnoidal hemorrhage were pains, tunicary symptoms and blood-containing character/nature of cerebro-spinal fluid.

Pains had diffuse character/nature and they were expressed more strongly, the more abundant there was the hemorrhage and the weaker was damaged the spinal cord or the horse tail.

During the hemorrhages in the region of the horse tail of pain in the first hours and days they frequently achieved extreme intensity. A. S. Orlovskiy, who worked in the foremost stages, writes that "these casualties even before the introduction them into the operating room could be learned on their cries and complaints".

As is known, during the spontaneous sub-arachnoidal hemorrhages pains appeared immediately, only growing on in its intensity in proportion to the outflow of the blood. During the sub-arachnoidal

hemorrhages on the soil of the bullet wounds of spinal cord this type of their development was observed rarely. More frequent than the pain they appeared through several hours after wound, in proportion to an improvement in conducting nerve impulses for spinal cord and rootlets of horse tail in connection with the reverse development of cerebrospinal shock. During the full/total/complete violation the conductivities of the spinal cord of pain down from the stricken area were absent.

The objective symptoms of the stimulation of cerebral shells (stress/voltage of postcranial muscles, symptoms of Kernig and Brudzinski) frequently in one and the same casualty sharply were distinguished by intensity. Thus, during the rough damages/defeats of spinal cord, and also in the stage of cerebrospinal shock when the sharp postcranial muscle tension is present, the symptoms of Kernig and Brudzinski were expressed weakly or they were absent.

The course of sub-arachnoidal hemorrhages with the nonpenetrating wounds of spine and its penetrating wounds with the violation of the integrity of solid cerebral shell presented essential differences. In the presence of defect in the solid cerebral shell, because of the escape of cerebro-spinal fluid, sub-arachnoidal space comparatively rapidly was freed/released from the blood.

In connection with this tunicary symptoms and radicular pains weakened or disappeared during the next several days. Since the significant part of the issuing from blood was driven out together with the cerebro-spinal fluid, any large/coarse sub-arachnoidal hematomas with the large defects in the solid cerebral shell usually were not developed.

On the contrary, with the nonpenetrating wounds of spine, and from those penetrating with those, with which solid cerebral shell was not damaged, the blood was saved/accumulated in the sub-arachnoidal space; therefore cerebro-spinal fluid comparatively for long retained blood-containing character/nature, but radicular pains and tunicary symptoms - their original intensity. Relatively large/coarse hematomas in this genus the cases were observed more frequently than in the presence of large defects in the solid cerebral shell.

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Diagnosis. The appearance of sharp radicular pains and tunicary symptoms directly or into the nearest hours after wound at a normal temperature was considered sufficient for the establishment of

diagnosis. Errors occurred only when the symptoms of Kernig and Brudzinski were weakly expressed, and postcranial muscle tension was examined/scanned or his value was underestimated. In the doubtful cases, and also for the differential diagnosis with meningitis they resorted to the lumbar puncture. Experiment/experience showed that sub-arachnoidal massive hematoma can be assumed when when of the tunicary symptoms, blood in the cerebro-spinal fluid and of the partial or full/total/complete blockade of sub-arachnoidal space is present, were absent radiographic indications of the possibility of the compression of spinal cord by foreign bodies.

Treatment - strict rest, substances, which raise the coagulability of the blood (calcium chloride, ascorbic acid). Were applied also lumbar punctures with the extraction of cerebro-spinal fluid. During the first 2-3 days one should have extracted not above 5-10 cm<sup>3</sup> in order not to cause the renewal of hemorrhage.

Traumatic radiculites and meningo-radiculites.

As the more or less isolated/insulated damage/defeat traumatic radiculitis was more frequently one-sided. Its reason was usually the straight/direct damage of the extravertebral division of rootlets by the wounding shell or bone fragments. When was damaged the intravertebral division of rootlets, to the pains usually were

connected different intensity tunicary symptoms as a result of the hemorrhage into the epidural space (meningo-radiculitis). meningo-radiculites were more frequently bilateral.

With the wounds of the brachial and lumbar plexus rarely to the basic symptoms of plexitis were connected radicular (radiculo-plexitises), and sometimes also cerebrospinal phenomena (myelo-radiculo-plexitises). The mechanism of the damage of rootlets and brain with this genus wounds consisted, apparently of the high tension of rootlets of web/plexus at the moment of colliding with them the wounding shell, which affects the spinal rootlets, and through them and to the spinal cord.

Radiculites and radiculo-plexitises more frequently were observed with the paravertebral and nonpenetrating wounds of spine, but meningo-radiculites - with the penetrating wounds, mainly with the tangents and the blind ones, but not escorted/tracked by the rough damage of spinal cord.

The basic symptom of radiculites and radiculo-plexitises were pains. The latter, especially with the wounds of lower-neck and lumbar-sacral division of spine, frequently achieved very large intensity. Sometimes pains acquired causalgic hue. Radicular type motor and sensitive disorders, and by equal mode and the violation of

reflexes, trophic system of muscles, skin and its appendages were found in direct dependence on the degree of the damage of rootlets. During the damage of neck rootlets frequently was noted the forced position/situation of head due to the reflector spasm of neck musculature. As a result of multiple failure of the neck division of frontier sympathetic shaft, its ganglia/nodes either connective branches to the radicular disorders was connected syndrome Claude Bernara-Gorne or sympathetic pains, which irradiate into the hand, the occiput, the person.

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The disorders of urination were observed rarely and they carried short-time character/nature.

The diagnosis of the radicular syndrome was based on the radicular character/nature of motor and sensitive violations in the absence or weak manifestation and instability of cerebrospinal disorders.

Treatment. By themselves radicular pains with the paravertebral ones and with the nonpenetrating wounds of spine in the sharp/acute and early period rarely served as occasion for surgical interventions. With the penetrating wounds it was necessary sometimes

to be added/interfered in the cases of the jamming of rootlets in the intervertebral aperture by the wounding shell or bone fragment. In the remaining cases were limited by designation/purpose, if necessary, usual soothing substances. For the purpose of warning/prevention of the appearance of radicular pains subsequently one should have during the primary processing of wound thoroughly driven out the bone fragments, which are arranged/located in the neighborhood with the rootlets. On the healing of wound for the treatment of radicular pains were applied different forms/species of physiotherapy.

Within the later periods with the severe pains sometimes it was necessary to be added/interfered for releasing the rootlets from post-wound cicatrices when the energetically carried out reabsorbing therapy did not exert positive activity.

One of the frequent reasons for reinforcing of radicular pains within the later periods were osteomyelitic processes in the vertebrae, and also periostitis in the region of the intervertebral apertures.

Long existed traumatic lumbar-sacral radiculites, especially bilateral, frequently led to the development of the heavy contractures of lower extremities, and radiculites of neck rootlets -

to the contractures of neck muscles with the distortion of the position/situation of head.

With the wounds of spine, which were being escorted/tracked by the simultaneous action of the blast of large force, on the side of body, which was subjected to its action, were sometimes observed diffuse (usually blurred) disorders motor, the sensitive, reflector (reduction or loss of reflexes) and vasomotor function, which were being escorted/tracked by dull pains. The latter frequently covered almost entire appropriate half body. M. S. Margulis considered these disorders as the disseminated meningo-radicular syndrome, caused by diffuse, one-sided epidural hemorrhage. Is more probable that these disorders were the consequence of the straight/direct contusing action of blast on the peripheral nerves and their terminal branchings, and also to the muscles and the vessels.

Contusion of spinal cord.

The more or less heavy contusions of spinal cord, according to materials the developments of the histories of disease/sickness/illness/malady, with the nonpenetrating wounds occurred into 31.70/o. They relatively more frequently were observed with the wounds of the thoracic division of spine (41.90/o of all violations of this division), and it is most rare - during the



damages/defeats of lumbar-sacral division (18.80/o), moreover mainly the I and II lumbar vertebra.

The full/total/complete transverse contamination of spinal cord (crushing) on the soil of its contusions was observed as an exception. As a result of the resorption of the focus of softening with the death of casualties in the intermediate and late period on the autopsies rarely was noted the picture seemingly of full/total/complete anatomical interruption of brain.

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The course of the contusions of brain was softer than with the penetrating wounds of spine; they were more rarely complicated by the suppurative diseases of shells, urinary system and by heavy bedsores.

Since the symptoms of the contusions of brain in the nonpenetrating wounds of spine essential differed in no way from the same with its penetrating wounds, they to avoid repetition are examined in Chapter II "Penetrating wounds of spine".

Surgical treatment of the nonpenetrating and paravertebral wounds of spine.

Candidate of medical sciences docent D. G. Goldberg.

With the nonpenetrating wounds of spine the contents of spinal canal was damaged by the mechanism of transmission shock.

Of the aforsaid above about pathogenesis and clinic of neurologic violations with the nonpenetrating (and paravertebral) wounds it is possible to see that 62.30/o of such wounds flowed/occurred/lasted without the neurologic violations or with the rapidly passing violations, and in the remaining cases was observed predominantly the partial violation of the conductivity of spinal cord or horse tail as a result of the jolt, the contusion or the violations of blood circulation. It is hence understandable that the readings to laminectomy, especially within the early periods, with such wounds were very narrowed<sup>1</sup>.

FOOTNOTE<sup>1</sup> Taking into account that appearing in this case changes in the spinal cord, its shells and rootlets (edema, hemorrhages, etc.) are not removed by surgical route/path. ENDFOOTNOTE.

Based on materials of the development of the histories of disease/sickness/illness/malady, laminectomy with the nonpenetrating wounds it is produced only into 3.10/o of cases (mainly apropos of ascending edema of spinal cord and compression by its hematoma).

Basic means of surgical intervention with the nonpenetrating wounds was the primary surgical processing of wounds with the removal/distance of available bone fragments and foreign bodies which was produced into 69.9o/c of such wounds.

With the blind-end wounds of the bodies of the vertebrae which are noted into 5.7o/o of all wounds, foreign bodies only in the rare cases were driven out during the primary processing of wounds. Bases for neurosurgeons' this tactics were not only the difficulties of access to the bodies of vertebrae and the need in this case for the considerable expansion of surgical intervention, but also the fact that the foreign bodies, which were delayed in the bodies of vertebrae, as showed experiment/experience, subsequently in the majority of the cases aseptic got accustomed to without the violations the functions of spine. Only in the late period, thinner/less frequent at the end of the intermediate period of wound the foreign bodies of this localization were driven out in the cases of the onset of osteomyelitis. Usually these operations/processes were performed in the specialized hospitals of the front or deep rear.

With the confidence in the absence of the damage of spine

(careful X-ray examination, analysis of wound canal, etc.), i.e., with the paravertebral wounds, early laminectomy, with rare exception, was not conducted despite the fact that with them was always a more or less considerable violation of the conductivity of spinal cord or horse tail.

Laminectomy with the paravertebral wounds, is more frequent explorative, in connection with the heavy radicular pains or the build-up/growth of paralytic phenomena it is produced in all into 1.80/o of similar wounds.

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As occasion for explorative laminectomy with the paravertebral wounds served the assumption of the erroneous treatment of X-ray photographs.

In this case it was considered that the fine/small bone fragments in the spinal canal can prove to be invisible in the review X-ray photographs and that the perforating possible penetrating wound of spine without the damage to bone (with the passage of the wounding shell through intervertebral apertures with the wound in the frontal plane).

At the end of the intermediate and in the late period with the paravertebral and nonpenetrating wounds appeared the readings to laminectomy in connection with the development of hyperplastic and adhesive processes in the shells (arachnoiditis, external pachymeningitis, etc.), which led to onset or build-up of motor, sensitive and dystrophic violations.

The nonpenetrating wounds of spine in the intermediate or late period into 21.7o/o were complicated by osteomyelitis (see below). Undertaken in this case sequestrotomy, especially in this case sequestratomy, especially with osteomyelitis of small arcs, was frequently finished by laminectomy. Thus, in the early period the surgical treatment of nonpenetrating and paravertebral wounds was reduced in essence to the treatment of wound, prophylaxis and treatment of different complications, and also to the treatment of the associated wounds of other organs/controls and systems with the combined wounds.

The correct classification of casualties with the nonpenetrating wounds of spine had special importance and presented sizable difficulties for the therapeutic institutions of army area (DMP, <sup>KL</sup>PPG of the first line). From the point of view of the line-of-communication principle of treatment with such wounds they distinguished:

1. Wounds with the insignificant damage of the integuments: a) without expressed neurologic violations and b) with the expressed neurologic violations.

In the first case of casualties they usually guided into the general-surgical separations/sections of <sup>Kh</sup>PPG even less frequently in GLR (GBA), where with the appropriate clinical picture was detected the damage of spine. Casualties with the isolated/insulated damage of awned or cross extensions in third of cases almost completed treatment in GBA; those needing treatment more than 1-1 1/2 months guided into the specialized hospitals GBF.

In the second case the damage of spine did not remain in doubts, and casualties they guided into the specialized neuro-surgical agencies GBA or even GBF (under the favorable conditions of evacuation and in the presence of transport means). In these institutions was conducted conservative or surgical treatment from the readings, given above. The damaged awned and cross extensions drove out usually only with the stable pains or with the onset of osteomyelitis; during the damage of the bodies of vertebrae, almost as a rule, they operated only in the case of the onset of osteomyelitis.

2. Extensive, crushed (and contaminated) wounds: a) without expressed neurologic violations and b) with expressed neurologic violations.

In the first case, almost as a rule, wounds they underwent primary surgical processing with the removal/distance of available foreign bodies and bone fragments. After being convinced of the damage of spine, the surgeons of army area guided such casualties into the specialized hospitals of army or front.

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In the second case, in proportion to gaining of experience, changed surgical tactics. To 1943 such wounds underwent primary surgical processing in the therapeutic institutions of army area. Operation/process without the X-ray examinations led frequently to the fact that either during the processing remained uneliminated/unremoved the unit of the bone fragments and the foreign bodies or sometimes without the sufficient bases is produced laminectomy of 1-2 vertebrae. Since 1943 in the therapeutic institutions of army area with similar wounds the surgeons were limited to dress/lavatory of wound and by the most rapid possible

evacuation of casualties into the specialized agencies of GBA. Operated such casualties only in the case of the forced delay evacuations, with the phenomena of infection in the wound or during the damage of considerable muscular masses. Under these conditions the surgeons were usually limited to the dissection of wound and to the removal/distance of diffused tissues.

In the specialized hospitals of afterward surgical, neurologic and roentgenological examination/inspection the casualties underwent the most radical possible primary surgical processing of wound.

Paravertebral wounds were always escorted/tracked in the sharp/acute and early period of wound by the more or less considerable violations of the conductivity of spinal cord or horse tail and therefore them they accepted as the wounds of spine. Hence classification, and surgical tactics with them in the army area did not differ from those described for the nonpenetrating wounds of spine with the expressed neurologic violations. In the specialized neuro-surgical hospitals the diagnosis was more precisely formulated and treatment was conducted in accordance with the given above positions.

With the combined wounds with the damage of the organs/controls of thoracic or abdominal area the nonpenetrating wound of spine they



considered as that associating and subjected to the primary surgical processing (previously dissection), together with intervention apropos of the wound of cavitary organs/controls, or they deposited operation/process on the spine for the later period. Those obtained the combined nonpenetrating and paravertebral wounds with the expressed neurologic violations they evacuated into the specialized neuro-surgical hospitals, and with the combined nonpenetrating wounds without the expressed neurologic violations - into the general-surgical hospitals where was revealed/detected the wound of spine sometimes only with the onset of complications from the side of spine (osteomyelitis) or contained spinal canal (arachnoiditis, pachymeningitis, etc.).

Complications with the paravertebral and nonpenetrating wounds of spine.

The most characteristic complications of nonpenetrating wounds were different infectious complications, especially osteomyelitis. The reason for this can be seen in the insufficiently radical primary surgical processing of wound and in a comparatively frequent damage of bodies or apophyses of vertebrae with this means of wound.

During the analysis of reasons it is insufficient the radical surgical processing of the wounds, which were relating to 4/5 cases

to the wounds, processed on DMP and in KhPPG of the first line, it was possible to establish that such reasons at least three:

1) operation/process was conducted without the X-ray photographs; therefore in the wound remained available to removal/distance bone fragments;

2) the difficulty of access to the bodies of vertebrae with their damages;

3) among the nonpenetrating fragmentation wounds into 54.0o/o were noted they were multiple fragmentation wounds, moreover fine/small foreign bodies proved to be scattered in the soft tissues: to radically treat this wound was impossible.

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Meningitides and suppurative meningomyelites with the nonpenetrating wounds of spine, according to the data of the development of the histories of disease/sickness/illness/malady, were observed into 1.3o/o, the abscesses of spinal cord - into 0.3o/o. Based on materials of the personal observations of the individual authors, which relate in essence to GRP, suppurative meningitides were from 3.0 to 5.0o/o. Rarely were observed suppurative

pachymeningitis.

The basic sources of suppurative complications were paravertebral ulcers, which appeared around the foreign bodies, osteomyelitis, which were festering epidural less frequently thinner/less frequent than intermuscular hematomas, rarely bedsores. These should be explained the fact that the suppurative complications in the shells of spinal cord with the nonpenetrating wounds appeared in the intermediate and even late period, i.e., 1-4 1/2 months after wound.

Prophylaxis of suppurative complications consisted of the removal/distance of the paravertebrally arranged/located foreign bodies, of the timely autopsy of paravertebral ulcers and of the struggle with osteomyelitis.

Are comparatively rare were rare severe complications from the side of urination system (6.30/o), and also heavy bedsores (4.20/o).

In 3.90/o of nonpenetrating and paravertebral wounds was superimposed superpubic fistula.

From Table 23 it is evident that festerings of wound more frequently were noted after the primary surgical processing of wounds, which was being escorted/tracked by the removal/distance of bone fragments and foreign bodies.

Table 23. Frequency of infectious complications with the various forms of the primary surgical perfecting of the nonpenetrating wounds of spine (in the percentages).

Осложнения (1)	Первичная хирургическая обработка и ее характер (2)			Всего (7)
	(3) рассечение раны	(4) рассечение раны	(5) с удалением костных осколков	(6) с удалением костных осколков и инородных тел
Нагноение раны (8)	21,3	16,1	21,2	21,0
Столбняк (9)	0,7	—	—	0,1
Анаэробная инфекция (10)	1,1	—	0,9	0,2
Остеомиелит позвонка (11)	29,6	37,7	26,0	21,7
Абсцесс спинного мозга (12)	0,4	—	0,4	0,1
Менингит (13)	1,6	0,7	0,2	1,3
Сочетание различных инфекций (14)	4,3	3,4	5,5	4,1
Сепсис (15)	1,8	2,1	—	1,4
Прочие инфекционные осложнения (16)	2,1	1,4	3,0	2,5
Не было осложнений (17)	45,1	38,3	39,1	43,8
Итого (18)	100,0	100,0	100,0	100,0

Key: (1). Complications. (2). Primary surgical perfecting and its character/nature. (3). dissection of wound. (4). Same as key 3. (5). with removal/distance of bone fragments. (6). with removal/distance of bone fragments and foreign bodies. (7). In all. (8). Festering wound. (9). Tetanus. (10). Anaerobic infection. (11). Osteomyelitis of vertebra. (12). Abscess of spinal cord. (13). Meningitis. (14). Combination of different infections. (15). Sepsis. (16). Other infectious complications. (17). It was not complications. (18). Altogether.

Hence it is possible to draw only the one conclusion that the blind-end wounds (frequently with many fine/small fragments of shell or mine, which are diffused in the soft tissues) present greatest difficulties during the radical surgical perfecting. On the role of foreign bodies in the pathogenesis of suppurative processes in the wound testifies the fact that with the onset of osteomyelitis after the blind-end wound of one sequestrotoomy usually it proved to be process it was insufficiently and eliminated only after the removal/distance of the adjacent foreign body.

The incomplete removal/distance of bone fragments and foreign bodies raised a number of complications of osteomyelitis. This frequently related to the wounds of the regions, hard-to-reach to the radical perfecting (neck division, rump). Simultaneously the possible removal/distance of bone fragments and foreign bodies decreased a number of complications of meningitis with the nonpenetrating wounds of spine from 1.6 to 0.7-0.9o/o.

Thus, different infectious complications were observed more than in the half all nonpenetrating wounds of spine, moreover large part fell to infection of wound and osteomyelitis. This leads to the conclusion about the need to more carefully treat wound canal with

the nonpenetrating wounds, driving out as far as possible bone fragments and foreign bodies.

Lethal outcomes with the nonpenetrating and paravertebral wounds were insignificant percentage, moreover almost in the half the cases it was possible to connect them with the combined or associated wounds of organs/controls by the heap of cell, abdominal area or small pelvis. This remaining wounded groups perished from the sepsis as the consequences of osteomyelitis, urinary infection or wound infection (anaerobe). The small unit of the casualties perished after sequestrotomy apropos of osteomyelitis of rump or bodies of neck vertebrae.

In 2.00/o of nonpenetrating wounds of spine the casualties perished from meningitis, which arose from the osteomyelitic focus or the infected wound canal.

In essence casualties perished not from the damage of spinal cord, but from the wound of internal organs/controls by the same wounding shell.

The correctness of this conclusion confirms the relative frequency of lethal outcomes with the wounds of different divisions of spine. Thus, with the wounds of thoracic division, with which more

frequently simultaneously are wounded light and organs/controls of abdominal area, lethal outcomes were observed almost 3 times more frequently than with the wound of neck division. The wounds of lumbar-sacral division occupied in this respect the intermediate place.

Table 24. Issues of the nonpenetrating wounds of spine general/common/total and for its basic divisions (in the percentages).

Отдел позвоночника (1)	Исходы (2)	Трудоспособ- ность вос- становилась полностью (3)	Ограничен- ная трудо- способность (4)	Прочие исходы (5)
Шейный . (6)	(7)	41,6	49,7	8,7
Грудной . . . . .	(8)	36,8	38,8	23,4
Пояснично-крестцовый . (9)	(9)	38,1	48,8	13,1
Все отделы . . . . .	(9)	28,6	46,1	15,3

Key: (1). Division of spine. (2). Issues. (3). Ability to work was reduced completely. (4). Restricted ability to work. (5). other issues. (6). Neck. (7). Thoracic. (8). lumbar-sacral. (9). All divisions.

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But, together with this factor, the percentage of lethal outcomes depended on the fact that with the wounds of the thoracic division of spine the damages/defeats of spinal cord were heavier than with the wound of other divisions of spine. This appears from the following: the syndrome of the full/total/complete cross violation of the conductivity of spinal cord with the wounds of thoracic division was observed into 8.60/o, and with the wounds of neck division - in 3.3 %.



On the condition of spinal cord and rootlets of horse tail in dead persons in the early and intermediate period after the nonpenetrating wounds of spine gives representation Table 25, comprised based on materials of the development of the histories of disease/sickness/illness/malady.

Given data testify also about the fact that the damages of spinal cord and connected with this complications only in a small number of cases could be the reason for death with the nonpenetrating wounds of spine.

Functional issues in those survived after nonpenetrating wounds are sufficiently favorable.

The analysis of given data makes it possible to make following conclusions.

In survived after the nonpenetrating wounds of spine and paravertebral wounds good functional outcomes<sup>1</sup> were observed almost equally frequently with the wounds of all basic divisions of spine.

FOOTNOTE <sup>1</sup>. By good functional outcomes is understood the absence of

the expressed motor violations. The fallout of the isolated reflections, just as the violation of sensitivity, is not leading in the estimation of the issues of the bullet wounds of spine and spinal cord. ENDFOOTNOTE.

Monoplegia and monoparesis most frequently occurred in those affected into the neck division of spine.

Table 25. Discovered changes in the contents of vertebrate canal with the autopsy of dead persons in the early and intermediate period after the nonpenetrating wounds of spine (in the percentages).

Не было видимых изменений (1)	Поперечное размягчение спинного мозга (2)	Очаговый некроз и размягчение спинного мозга (3)	Гематома экстраду- ральная (4)	Кровоизли- вия под- оболочечные (5)	Поврежде- ния кореш- ков спинного мозга (6)	Всего (7)
50,0	11,2	22,2	5,6	5,5	5,5	100,0

Key: (1). It was not the visible changes. (2). Cross softening of spinal cord. (3). Focus necrosis and softening of spinal cord. (4). Hematoma extradural. (5). Hemorrhages subcortical. (6). Damages of rootlets of horse tail. (7). In all.

Table 26. Clinical issues after nonpenetrating wounds on the levels of the wound of spine (in the percentages) (motor and trophic violations).

Отдел позвоночника (1)	Исходы (2)	Хороший функциональ- ный от- клик (3)	Монопарез (4)	Спинальный гемипарез (5)	Парапарез (6)	Монопарез (7)	Спинальный гемипарез (8)	Парапарез (9)	Трофический язва (10)	Сочетание (11)
Шейный (12)		69,0	1,2	0,5	—	9,7	5,1	8,3	—	6,2
Грудной (13)	(14)	71,5	—	—	0,5	5,4	1,7	15,3	0,9	7,7
Пояснично-крестцовый		72,3	0,1	0,1	0,2	6,8	0,5	10,1	0,5	8,3
Все отделы (15)		71,7	0,3	0,2	0,2	7,3	1,9	11,2	0,5	9,7

Key: (1). Division of spine. (2). Issues. (3). Good in functional sense. (4). Monoplegia. (5). Spinal hemiplegia. (6). Paraplegia. (7). Monoparesis. (8). Spinal hemiparesis. (9). Paraparesis. (10). Trophic ulcer. (11). Combination. (12). Neck. (13). Thoracic. (14).

Lumbar-sacral. (15). All divisions.

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Of paraplegia as residual phenomena they were observed rarely, besides mainly with the wounds of thoracic division. Considerably more frequently occurred parapareses, which were being most frequently observed with the wounds of thoracic division. But on the whole clinical issues in the survived afterward nonpenetrating and paravertebral wounds were found in the relatively weak dependence on the level of the wound of spine and as a whole they were relatively favorable.

Thus, the paravertebral and nonpenetrating wounds of spine can be related to the average/mean on the severity forms of the bullet damages/defeats of spine.

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## Chapter II.

### Penetrating wounds of spine.

The penetrating wounds of spine, or the wounds, which were being escorted/tracked by the damage of the integrity of the walls of spinal canal, were observed into 56.20/o; among them the tangents were 38.70/o, blind - 29.40/o, fragmentation - 31.90/o.

According to the means of the wounding weapons tangential wound they were deposited equally frequently by both the bullets and by fragments. Among the perforating wounds bullet were observed approximately/exemplarily doubly more frequently than fragmentation, while among the blind ones, on the contrary, the fragmentation wounds were observed 2 times more frequent than bullet ones (Table 2).

The penetrating wounds frequently were accompanied by the damage of solid cerebral shell. According to the personal observations of the author (GBF), with the penetrating wounds of spine, checked on

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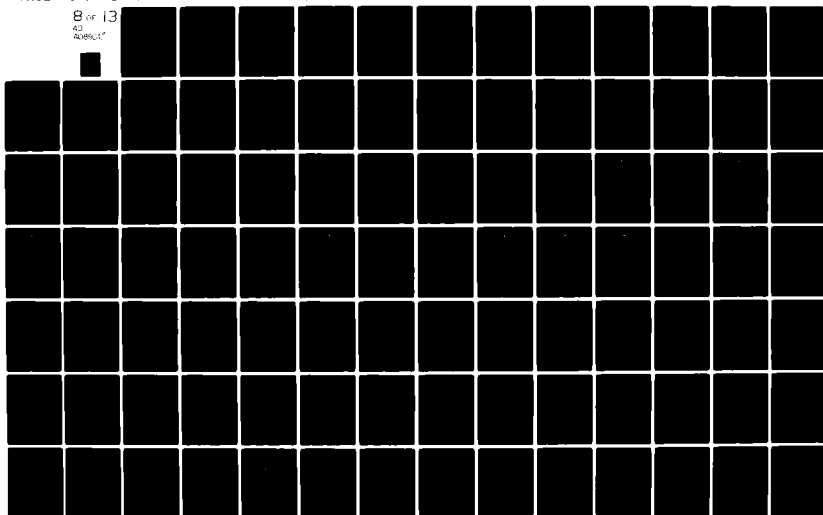
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the operation/process or on the autopsy (74.10/o of all cases of the wounds of this genus), the damage of solid cerebral shell was discovered into 62.60/o. This numeral close to that established/installed according to the data of the protocols of autopsies and reports of PAL (65.90/o). M. P. Postolov on 88 blind-end wounds of spinal canal, confirmed on the operation/process or on the autopsy, revealed/detected the damage of solid cerebral shell into 76.00/o, and Ye. Ya. Briskman - into 40.80/o. However, the real percentage of the damages of solid cerebral shell with the penetrating wounds remains unknown. On one hand, in certain unit of the casualties with the penetrating wounds, but not undergoing laminectomy, also could occur the wound of solid cerebral shell, while on the other hand - with the blind-end wounds by fine/small metallic fragments sometimes also it was not applied laminectomy and therefore the condition of shell in them remained unchecked/unverified.

Based on materials of the personal observations of a number of the authors, the damage of solid spinal cord was observed more frequently with the fragmentation wounds. Thus, according to I. Ya. Razdol'skiy's data (GBF), in the cases of the bullet penetrating wounds checked the damage of solid cerebral shell occurred into 52.00/o, with the fragmentation ones - into 73.20/o. Similar data gives M. P. Postolov based on materials of the specialized hospital

of front line area.

This difference in the frequency of the damages of solid cerebral shell depending on the form/species of the wounding shell is especially great with the blind-end penetrating wounds of spine. With the blind-end bullet wounds solid spinal cord was damaged into 62.50/o and with the fragmentation ones - into 80.00/o (I. Ya. Razdol'siy). The larger percentage of the damage of solid cerebral shell with the fragmentation wounds is explained by the fact that with these wounds the sharp/acute fragments, frequently with the notched edges, more easily disturbed the integrity of shell.

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Presented facts have not only theoretical interest, but also practical value. As a result of the defect in the solid cerebral shell sharply is raised the danger of the heavy infection of sub-arachnoidal space and substance of brain. The high frequency of the damages of solid cerebral shell with the blind-end fragmentation wounds of spinal canal was, apparently one of the reasons and the larger frequency of the onset with them of severe suppurative complications. According to the material of the personal observations of the author, of 34 blind-end bullet wounds of spine with the determination of foreign body in the spinal canal none was



complicated by the suppurative damage/defeat of shells or brain, but of 75 fragmentation ones were complicated by 9, i.e., 12.00/o. According to the observations of other authors blind-end bullet wounds were considerably more rarely complicated by suppurative meningitis than fragmentation.

The damage of spinal cord with the penetrating wounds not only was observed more frequently than with the nonpenetrating ones, but it, as a rule, was considerably heavier (Table 27).

In the group of the penetrating wounds, with which, according to the materials of the development of the histories of disease/sickness/illness/malady, neurologic violations were expressed weakly or they were absent (8.20/o), were connected not only such wounds, with which these violations rapidly passed, but, apparently also wounds, with which the casualties perished, before produced any detailed neurologic examination/inspection. Thus, the actual numeral of the penetrating wounds, with which neurologic violations were absent or they were expressed weakly, must be considerably below.

The heavy forms of the damage/defeat of spinal cord most frequently were observed with the wounds of the thoracic division of spine - 69.90/o with the full/total/complete violation of the conductivity of brain, and most rarely - with the wounds of lumbar-sacral division - 28.30/o. With the wounds of latter/last division of the whole cross syndrome was observed mainly in the region of cone and epicone and it is very rare - horse tail.

Table 27. Frequency and severity of neurologic violations with the penetrating wounds of spine at different levels (in the percentages).

Степень повреждения спинного мозга (1)	Для всего позвоноч- ника (2)	(3) Отдел позвоночника		
		(4) шейный	(5) грудной	(6) пояснично- крестцовый
Неврологические нарушения от- сутствовали или были выра- жены слабо (2) . . . . .	8,2	11,2	4,2	9,1
синдром полного нарушения проводимости спинного мозга и конского хвоста (3) . . . .	46,9	42,3	69,9	28,3
синдром частичного нарушения проводимости спинного мозга (9)	33,6	45,3	23,5	31,0
синдром частичного нарушения проводимости корешков кон- ского хвоста . . . . (10) . . . .	11,3	—	2,4	31,6
Итого (11).	100,0	100,0	100,0	100,0

Key: (1). Severity of the damage of spinal cord. (2). For entire spine. (3). division of spine. (4). neck. (5). thoracic. (6). lumbar-sacral. (7). Neurological violations were absent or they were expressed weakly. (8). Syndrome of full/total/complete violation of conductivity of spinal cord and horse tail. (9). Syndrome of partial violation of conductivity of spinal cord. (10). Syndrome of partial violation of conductivity of rootlets of horse tail. (11). Altogether.

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Among the penetrating wounds of spine the especially heavy forms of the damages/defects of spinal cord were observed with the

perforating and blind-end wounds of the latter. According to the data of GBF of Leningrad Front, in the early period with the perforating penetrating wounds of spine the full/total/complete violation of the conductivity of spinal cord occurred into 91.70/o, with the blind ones - into 74.50/o, with the tangents - into 29.30/o. For the horse tail these numerals were considerably below.

MECHANISMS OF DAMAGE OF SPINAL CORD AND ITS ROOTLETS WITH PENETRATING WOUNDS OF SPINE.

Corresponding member of the Academy of medical Sciences of the USSR, meritorious worker of science, professor I. Ya. Razdol'skiy.

The factors, which participate in the deposition to the spinal cord of damage for the penetrating wounds of spine, are extremely complex and multi-modes. Besides those factors which will inflict damage on to spinal cord with the nonpenetrating wounds of spine - damage and reflector spasm of the feeding brain vessels, mechanical brain concussion, contusion of the brain of that bending in to the instant into the lumen of spinal canal by small arc or by displaced body of vertebra (pg. 209), here act new traumatic factors. Basic of them are the following: direct activity on the spinal cord of the wounding shell, bone fragments, driven in or carried off by it after themselves in the lumen of spinal canal, and sharp fluctuations of the pressure of cerebro-spinal fluid.

With the blind-end and perforating penetrating wounds of spine the wounding shell, and also bone fragments either contused spinal cord and rootlets of horse tail, acting through the undamaged/uninjured solid cerebral shell, or, after opening the

latter, they deposited on them wounds, destroying them in full or in part (Fig. 85 and 86). If bullet or large/coarse fragment met on their route/path any sector of spinal cord, they broke its, and remaining unit of the diameter of brain to a certain degree were crushed (Fig. 87). Fine/small fragments frequently pierced spinal cord right through, but sometimes and bullet can pierce spinal cord, after destroying central division and after leaving macroscopically by those not damaged/not injured its side members. The perforating bullet wounds of spinal cord presented large rarity.

S. obtained 22/XII 1941 the perforating zero wound of chest with the perforating penetrating wound of spine at the level of thoracic vertebra and the syndrome of the full/total/complete violation of the conductivity of spinal cord. After 3 days it is delivered into the specialized hospital of GBF. The neurologic full/total/complete violation of the conductivity of spinal cord from the sixth thoracic segment (from this level does not down perceive the compression of skin, gastrocnemius muscles, fingers, feet). Solid edema of lower extremities. Paralysis of the organs/controls of a small pelvis. Bedsores on the rump (they appeared on the 2nd day). On the 11th day lethal outcome. The autopsy: bullet penetrated in the chest somewhat to the right from the breast bone, it traversed the upper fraction/portion of the lung into the spinal canal, the central division of spinal cord and moved out on 1 cm to the left of the

awned extension of the V thoracic vertebra. On the spot of inlet in the spinal cord of the edge of wound canal it is slightly drawn in; on the spot of exit - are somewhat turned. Through the wound canal freely is passed thick probe. The lateral divisions of spinal cord are preserved, but in them are noted the signs of contusion.

The damage of spinal cord lengthwise usually was more extensive than up to the larger distance in the vertical direction (downward or upward) advanced along the canal bullet or large/coarse fragment (Fig. 88).

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Fig. 85. Blind-end bullet penetrating wound of chest and spine at the level of VI thoracic vertebra. Is visible the bullet, which penetrated with sharp end in the substance of spinal cord and caused the full/total/complete transverse contamination of the latter. On the internal surface of solid cerebral shell is visible the organized blood clot. Preparation VMM No 802. (Artist T. V. Belyayeva<sup>va</sup>).

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Fig. 86. Blind-end fragmentation penetrating wound of lumbar division of spine. The region of medullary cone and the unit of the rootlets of horse tail are destroyed. Among the destroyed rootlets lies/rests the fold of the blood and metallic fragment 5x2 mm. Preparation VMM No 859. (Artist T. V. Belyayeva).



Page 232c.



Fig. 87. Tangential bullet penetrating wound of spine with break of small arc of X thoracic vertebra. At the level of the first and second lumbar segment the rough decomposition of the substance of spinal cord. Preparation VMH No 190. (Artist T. V. Belyayeva).

Page 232d.



Fig. 88. Perforating fragmentation penetrating wound of thoracic division of spine. Extensive vertical decomposition of spinal cord in the region of posterior columns with the cavitation. Sharp

vasodilation of brain and solid cerebral shell. In the latter are visible separate fine/small localized hemorrhages. Preparation VMM No 3222. (Artist T. V. Belyayeva).

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Main focus in the spinal cord appeared, as a rule, in the place of the straight/direct action of the wounding shell or bone fragments. But the zone of damage, especially with the large/coarse sizes/dimensions of the wounding shell, sometimes emerged far beyond the limits of the direct contact of the wounding shell with the spinal cord. Evidently, the wounding shell, touching the spinal cord or the horse tail, not only wounded or contused them, but also stretched, it compressed and shook, than it considerably expanded zone of its lateral action. The mechanism of tension was, apparently the reason for the frequently observed onset of foci in the cone and epicone with the perforating and blind-end wounds of spine at the level of the latter/last three lumbar vertebrae, with which the wounding shell penetrated through the solid cerebral shell. Running against the rootlets of tail and sharply stretching their (Fig. 89), wounding shell frequently broke away the unit of the rootlets of the cone and epicone, after depositing on that on them itself damage.

Very important role in the pathogenesis of the onset of the

supplementary foci of damage with the penetrating wounds belongs to cerebro-spinal fluid. The wounding shell, penetrating into the area of canal, cause an instantaneous pressure increase of cerebro-spinal fluid (I. V. Davydovsiy). The latter, being fixed upward and downward on sub-arachnoidal space, damages rootlets, soft cerebral shells and spinal cord not only in immediate proximity of the place of the penetration of the wounding shell into the lumen of spinal canal, but frequently, also, at a great distance. The traumatization of soft cerebral shells by liquor wave was, apparently the basic reason for the onset of arachnoidal cysts and intergrowth in the distance from the place of the straight/direct action of the wounding shell on the spinal cord.

Its massive hydrodynamic activity the wounding shell exhibits in the places of the greatest accumulation of cerebro-spinal fluid. In the limits of the sub-arachnoidal space of spinal cord - this is the region of horse tail. With the blind-end and perforating wounds of this region the pressure increase of cerebro-spinal fluid must be especially strong, and the appearing liquor wave - by especially powerful/thick. Moving upward, it must deposit on cone and epicone of spinal cord very considerable damage (Fig. 90). The traumatization of cone and epicone by cerebro-spinal fluid and by suddenly stretched rootlets is the basic reason for so frequently observed a with the penetrating wounds spine at the level of the latter/last three lumbar

vertebrae of the combination of radicular and conical, and sometimes also epiconal violations.

The damage of the radicular vessels, especially arteries and veins of the very substance of spinal cord, or their spasm, causing the disorders of blood circulation, in turn, also complicated and expanded the zone of the direct effect of the wounding shell. Evidently, this mechanism played the significant role in the onset of ischemic and hemorrhagic foci, besides frequently at a great distance from the basic focus.

The penetrated in the lumen of spinal canal wounding shells (with the blind-end wounds) and bone fragments not only wounded or contused spinal cord, but also squeezed it. The compression of spinal cord with the penetrating wounds of spine in the sharp/acute and early period was conditioned on epidural or subdural hematoma.

It was above indicated that the damage of the spinal cord with the penetrating wounds of spine always is considerably heavier than with the nonpenetrating ones. But also with the penetrating wounds the severity of the damage of spinal cord to a considerable degree depended on mechanism and character/nature of wound. Most frequently the heavy forms of the damages of spinal cord were observed with the perforating penetrating wounds of spine (Table 28).

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Given in Table 28 data confirm the dependence between the character/nature of the wound of spine and the severity of the damage/defeat of spinal cord.

The syndrome of the full/total/complete violation of the conductivity of spinal cord most frequently was observed with the perforating penetrating wounds, somewhat thinner/less frequent with the blind ones and it is considerably thinner/less frequent with the tangential penetrating wounds.

This dependence cannot be disseminated to the damages/defeats of the horse tail laws governing damage of which with different in the character/nature wounds, as is known, others, than spinal cord.

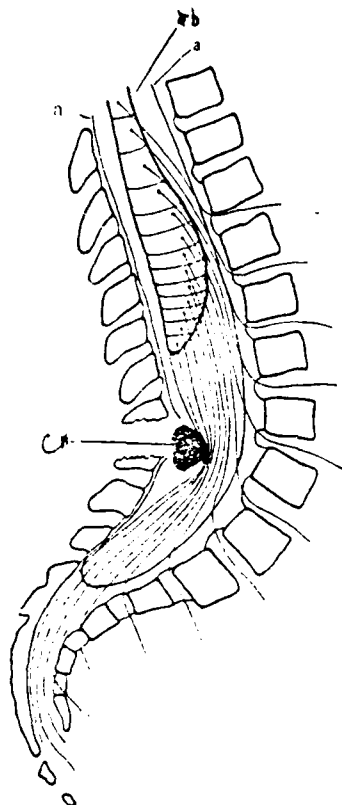


Fig. 89.

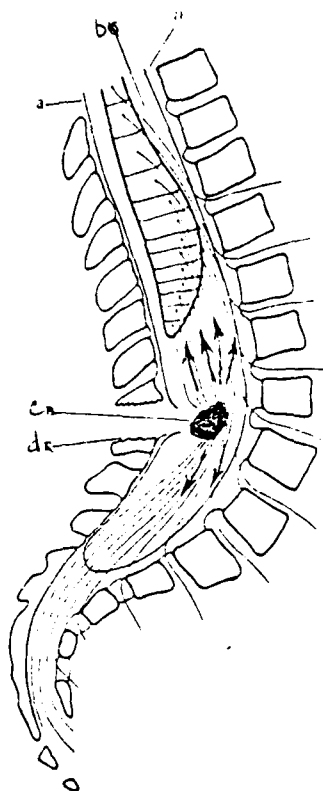


Fig. 90.

Fig. 89. Foreign body at moment of collision with rootlets of horse tail strongly stretches them; as a result frequently occurs breakaway of their unit of cone and epicone with damage of substance of latter. a) solid cerebral shell; b) sub-arachnoidal space; c) foreign body.

Fig. 90. Foreign body at moment of penetration into sack of solid cerebral shell causes sharp increase of pressure of cerebro-spinal

fluid. Rejected upward, the latter will inflict damage on to cone and epicone. a) solid cerebral shell; b) sub-arachnoidal space; c) foreign body; d) the defect, produced in the solid cerebral shell by foreign body. Arrows/pointers showed the direction, in which is fixed the cerebro-spinal fluid.

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According to separate authors' data, the full/total/complete anatomical interruption of spinal cord with the disagreement of its ends in the cases of the penetrating wounds of spine checked was observed into 13.0-14.00%. It was rarely noted with the contusions of brain by the large/coarse wounding shell through the undamaged/uninjured solid spinal cord, and mainly with the penetrating wounds by the latter. As a result of the resorption of the crushed sector of spinal cord its partial anatomical interruption, which saw the surgeon on the operation/process, into the later period, during the inspection/check on the autopsy, frequently was converted into the full/total/complete.

Most frequently the full/total/complete anatomical interruption of brain was observed with the penetrating wounds of the thoracic division of spine.



M. P. Postolov (GBF) with test laminectomy within the early periods, undertaken in 39 those wounded the thoracic division of spine with the syndrome of the full/total/complete violation of the conductivity of brain, revealed/detected the cross gap of spinal cord in 21 case; in the remaining 18 cases occurred his partial damage.

The multifeature action of the wounding shells on the spinal cord, besides not only to its that division, with which they came into the direct contact, but also to the near ones, but the sometimes and distant sectors of spinal cord, led to the very complex, especially in the sharp/acute and early period, the clinical picture of the penetrating wounds.

Table 28. Neurologic violations in the dependence on the character/nature of the penetrating wound of spine (in the percentages).

Характер ранения позвоночника	Неврологические нарушения		Синдром полного нарушения проводимости спинного мозга	Синдром частичного нарушения проводимости спинного мозга	Синдром повреждения копчикового хвоста	Неврологические нарушения отсутствовали или слабо выражены	Итого
	(1)	(2)					
Сквозные проникающие ранения	(8)	63,6	23,4	13,0	—	100,0	
Слепые проникающие ранения	(9)	43,9	29,9	25,6	0,6	100,9	
Посательные проникающие ранения . . . . .	(10)	22,8	39,0	25,3	12,9	100,0	

Key: (1). Character/nature of the wound of spine. (2). Neurologic violations. (3). Syndrome of full/total/complete violation of conductivity of spinal cord. (4). Syndrome of partial violation of conductivity of spinal cord. (5). Syndrome of damage of horse tail. (6). Neurologic disturbances were absent or are weakly expressed. (7). Altogether. (8). Through penetrating wounds. (9). Blind-end penetrating wounds. (10). Tangential penetrating wounds.

#### Clinical forms.

With the penetrating wounds of spine were observed all clinical forms of the bullet damages/defeats of spinal cord and horse tail: traumatic radiculitis, jolt, edema, sub-arachnoidal hemorrhage, hematoma, hematomyelia, contusion, wound.

Based on materials of the personal observations of the author (GBF), with the penetrating wounds of spine (without the horse tail) they were observed: traumatic radiculitis and meningo-radiculitis into 4.60/o of all cases, edema of spinal cord - into 10.80/o, sub-arachnoidal hemorrhage - into 1.50/o, hematoma - into 3.00/o, hematomyelia (tubular) - into 1.30/o, contusion, wound of brain - into 88.80/o. Thus, almost into 90.00/o of all penetrating wounds of spine were observed contusions and wounds of spinal cord.

The symptoms of the majority of these clinical forms are examined in chapter about the nonpenetrating wounds of spine. Are given below only some special features/peculiarities of their pathogenesis with the penetrating wounds.

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Radiculites and meningo-radiculites usually were observed with the tangential penetrating wounds, with which were damaged joint extensions or lateral divisions of small arcs. Especially severe pains appeared when foreign bodies whether bone scrap, without having applied the considerable damage to spinal cord or rootlets, strongly compressing latter/last or intervertebral ganglia/nodes. Very rigid pains were observed also, when fine/small metallic or bone fragments were stuck into the extradural or intradural cut of rootlets. During

wounds or compressions of the intervertebral ganglion/node rarely was noted the shingles. Already in the early period radicular pains sometimes served as occasion for surgical intervention.

Edema as the more or less isolated/insulated manifestation of the damage/defeat of spinal cord was observed considerably thinner/less frequent than with the nonpenetrating wounds. On the contrary, as the associated phenomenon with contusions and wounds of spinal cord, in particular, intra-medullary, it appeared frequently.

Sub-arachnoidal hemorrhages as the independent manifestation of the penetrating wound of spine were also observed rarely (1.50/o), besides, apparently mainly during the damage to fine/small metallic, it is more frequent bone, fragment of the particularly large/coarse arterial branch, which passes in the composition of the subdural cut of rootlets. As associating heavy contusions and wounds of spinal cord, they, judging according to liquorrhea and data of lumbar puncture, were observed frequently, approximately/exemplarily in the half all cases.

Hematoma, as with the nonpenetrating wounds, usually it appeared in the epidural space and more frequently was observed with the wounds of the posterior semiring of vertebra. In spite of the abundant vascular net/system in this space which, probably, was

damaged fairly often, large/coarse hematomas were noted rarely. Is explained this, apparently by the fact that in the majority of the cases the blood was secreted from the epidural space on the basis of the wound canal. Nevertheless the sizes/dimensions of some hematomas were so great that they could exert pressure on the spinal cord as, for example, in the following case.

S-n obtained 13/IV 1942 the perforating bullet wound of neck with the tangential penetrating wound of spine at the level of the VII neck vertebra. Immediately after wound the loss of consciousness for 1 1/2 hours, hemorrhage from the nose, paralysis of upper and lower extremities. 12 Hours after wound on one of the stages of evacuation is produced the dissection of input and outlet.

15/IV 1942 it entered into the Leningrad neuro-surgical institute with the clinical picture of the heavy violation of the conductivity of the spinal cord: paralysis of all four extremities, gross violation of sensitivity, delay of urine, severe pains in the neck and the occiput. X-ray analysis is the break of awned and right cross extension, and also small arc of the VII neck vertebra.

With laminectomy (through 78 after wound) in the area of spinal canal were discovered and removed the scrap of small arc of the VII neck vertebra. After removal/distance their pulsation of spinal cord

continued to be absent. Epidural cellulose was impregnated with the blood. On the surface of solid cerebral shell was disposed of the blood clot in thickness to 3 mm, the hidden linear defect in it. After the removal/distance of hematoma appeared living, synchronous to the respiration of the movement of solid cerebral shell.

Post-operation course is smooth. Wound healed by primary tension.

To the second day after operation/process appeared active movements in the shoulder, elbow, hip and knee joints. 14 Days after operation/process active movements were reduced in all joints of extremities. The normal function bladder was reduced through 9 days, rectum - through 3 weeks. In a month of patient with difficulty it began to walk and to service/maintain itself.

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Contusion and wound of spinal cord. In clinical sense the contusion and the wound of spinal cord had much in common. The maximum of the fallout of functions began immediately after wound. Approximately/exemplarily equally frequently were observed the loss of consciousness, general/common/total shock.

The degree of the fallout of conductor functions with both clinical forms was completely determined by the severity of the cross damage of brain.

The syndrome of the full/total/complete violation of the conductivity of spinal cord in survived on the average first 3-4 days after wound was noted into 46.90/o, besides somewhat more frequently with the wounds than with the contusions. This numeral during the next 2-3 weeks rapidly descended, on one hand, due to the death of casualties with the anatomical interruption of spinal cord, and on the other hand - due to the transition, in connection with the begun reduction of function, full/total/complete violation of the conductivity of the spinal cord into the partial.

Not only upon the transverse contaminations, but also with the rough contusions and the wounds of the spinal cord the disorders of conductor functions in the sharp/acute and early period had, as a rule, bilateral and uniform character/nature. With the light contusions and with the wounds of the substance of spinal cord by fine/small metallic or bone fragments the fallout of conductor functions from the very beginning sometimes predominated on one side; rarely it only several days was after expressed only on one side. During the damage/defeat of horse tail, with exception of comparatively rare cases of full/total/complete interruption,

violation of functions in the sharp/acute period they more frequently had asymmetric character/nature.

The phenomena of cerebrospinal shock were absent only with the light contusions and the wounds. The shock was continued the longer, the heavier there was the damage of spinal cord. In the suppressing number of cases paresis and paralyses in the sharp/acute period had flaccid character/nature. The transition of paralyses from flaccid ones to the spastic ones (during the damages/defeats of spinal cord it is higher than lumbar-sacral thickening) frequently was involved/tightened to many weeks.

In the sharp/acute and early period frequently (into 20.0-22.0o/o) was observed solid edema of the paralyzed extremities. During the damages/defeats of neck and lumbar-sacral thickening, and also horse tail appeared different intensity the atrophy of the corresponding muscles with weakening of electroexcitability, less frequently with the reaction of regeneration.

The disorders of sensitivity, depending on the severity of the damage of spinal cord and rootlets of horse tail, oscillated from the insignificant (less often) to total loss (46.9o/o). The upper level of its violation in the first 1-2 weeks usually descended, sometimes considerably, due to the reverse development the lying/horizontal it



is above additional foci, reactive edema, dynamic disorders of blood circulation. Pains initially usually were absent. It is comparatively rare, in proportion to the reduction of conductor and radicular functions, pains sometimes achieved large intensity. Exception were only the wounds of the region of horse tail, especially during the penetration of the wounding shell or bone fragments into the sack of solid cerebral shell. In these cases of pain they frequently achieved large force. During the determination of bullet among the rootlets of horse tail, as a rule, was observed perineo-anal radicular syndrome of position/situation.

Upon the full/total/complete transverse contaminations of spinal cord, which were not being complicated by arachnoiditis or peripachymeningitis it is higher than the focus, pains were absent also subsequently.

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The disorders of the functions of pelvic organs/controls in the sharp/acute period were absent only in the cases of light contusions and wounds of spinal cord. During the rougher damages of spinal cord they had heavy character/nature and purely they were complicated by cystitis, cystopyelitis and urosepsis. With the same degree of the damages of spinal cord these complications they appeared more

frequently and were the more heavily, the was arranged/located below the focus of damage.

Bedsores during the heavy damages/defeats of lower-thoracic and especially lumbar-sacral division of spinal cord and horse tail appeared very frequently. Appearing on the 3-4th day after wound and irrepressible progressing, they frequently led to the development of sepsis. During the heavy damages/defeats of the average/mean and lower-thoracic division of spinal cord, capturing series/number segments, were observed the serious violations of the functions of gastrointestinal tract, the being one of the reasons developments of depletion in casualties.

Changes of the cerebro-spinal fluid in the sharp/acute and early period were noted frequently. With the contusions of spinal cord, which were not being escorted/tracked by blocking of sub-arachnoidal space by foreign bodies or large/coarse epidural hematoma, its pressure was usually increased. With the wounds of spinal cord it at first more frequent was lowered/reduced in connection with the discharge of cerebrospinal fluid through the defect in the solid cerebral shell. The tests/samples of Pussep and Kvekkanshtedt' in these cases did not usually show the acceleration of the current of cerebro-spinal fluid, in spite of the absence of the blockade of sub-arachnoidal space.

## FOOTNOTE.

1. In the norm with the strong bending of head to the breast bone (test/sample of Pussep) or the compression of jugular veins on the neck (test/sample of Kvekkenshtedt) the escape of cerebro-spinal fluid is accelerated. Under conditions of the blockade of the sub-arachnoidal space higher than place for puncture it is not accelerated. ENDFOOTNOTE.

With the moderate contusions and the wounds of spinal cord by fine/small metallic and bone fragments the composition of cerebro-spinal fluid during the first days did not already present essential evasions from the norm. With the rough contusions and the wounds, which were being escorted/tracked by decomposition and crushing of the tissue of spinal cord, the content of protein and regular/prescribed elements/cells was usually increased. During the first days in the cerebro-spinal fluid sometimes were detected the smallest small pieces of tissue and drop of myeline. With the wounds of brain, it is thinner/less frequent with the contusions, in the cerebro-spinal fluid during the first days frequently was noted the admixture/impurity of the blood, sometimes very considerable, and later - different degree of xanthochromia. In the intermediate and late period the properties of cerebro-spinal fluid were determined by presence or absence of the blockade of sub-arachnoidal space. Connection in any period of suppurative complications from the side

of substance or shells of spinal cord caused inherent in them changes in the cerebro-spinal fluid.

With the penetrating wounds of spine the contusions and the wounds of spinal cord, almost as a rule (according to the observation data of the individual authors, into 75.0 - 90.0o/o), were combined with the compression by its wounding shell, bone fragments, less frequently with hematoma. If foreign bodies in proper time were not driven out, then, as showed operational intervention and data of autopsies in the intermediate and later period; they favored the development of heavy Rubtsovs pachymeningites and arachnoidites. Sometimes around them in these periods it was observed the education of abscess.

The penetrating wounds of spine nonpenetrating, were more frequently than complicated by the heavy suppurative damages/defeats of the substance of spinal cord and its shells. Thus, suppurative meningitides were observed into 8.2o/o of all penetrating wounds of spinal canal. They somewhat more frequently appeared in the unoperated casualties (8.8o/o), than in operated (7.1o/o). under the operation/process here is implied primary surgical processing.

Abscesses occurred into 0.40/o and also more frequently they appeared in the unoperated casualties. For the penetrating wounds of spine from the late complications are characteristic massive cicatrical pachymeningitis, is frequently the annularly covering sack solid cerebral shells and strongly compressing spinal cord, and also rough adhesive arachnoidites, especially in the region of horse tail.

#### Diagnosis.

During the careful clinical X-ray analysis of the wound of spine the recognition of its penetrating character/nature in the majority of the cases did not present essential difficulties.

Most reliable, although not frequent, by symptom of the penetrating wound of spinal canal was liquorrhea. It was revealed/detected already upon the first examinations/inspections of casualty. Since liquorrhea can be short-time, then, in view of the large value it as indications of the penetrating character/nature of wound, its presence it is extremely important to note in the map/chart/card of forward area and in the history of disease/sickness/illness/malady.

To the radiographic examination/inspection of casualty important data for the recognition of the penetrating character/nature of the

wound of spine with the perforating wounds of body can be obtained by surgical experiment. If the mental reproduction of wound canal (on the disposition of input and outlet) allows/assumes its intersection with the spinal cord, then the penetrating character/nature of the wound of the latter was considered as the very probable. During the utilization of this method it is necessary to consider the position/situation which occupied the casualty at the moment of obtaining the wound. But the experiment/experience of the Great Patriotic War showed that most important data for the recognition of the penetrating character/nature of the wound of spine provides the careful analysis of the well carried out X-ray photographs of the latter. If wound relates to the I, II and III type, i.e., the perforating, blind-end or tangential wound of spinal canal, its penetrating character/nature is indubitable.

Far not all roentgenologists, especially during the first years of war, gave exhaustive conclusions against the ratio of wound canal or foreign body to the spinal canal. Thus, clinician on the basis of the study of X-ray photographs had to itself solve these problems, and with the blind-end wounds of spinal canal and a question about direction and degree of the advance of foreign body on it. Personally the author during the decision/solution of this question utilized the following method, based in the studies of the X-ray photographs of spine taking into account the disposition of inlet and of his

relations and the places of the occurrence of the wounding shell to the spinal canal and to the center line of body.

Reference point for determining of the dimensions of canal in the X-ray photographs were the sizes/dimensions of the bodies of vertebrae. As is known, in the neck division the maximum sagittal size of the section of spinal canal corresponds to the approximately/exemplarily front-posterior size/dimension of the body of vertebra, seen in the profile X-ray photograph. The maximum cross size of the section of spinal canal in upper neck vertebrae somewhat more, and in lower ones - it is approximately equal to the diameter of the body of vertebra, seen in front X-ray photograph.

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Beginning from upper-thoracic vertebrae, the ratio of the sizes/dimensions of canal to the sizes/dimensions of the bodies of vertebrae is begun it is gradually decreased also at the level of average/mean thoracic vertebrae the frontal and sagittal sizes/dimensions of the section of canal they compose approximately/exemplarily the half the maximum sizes of the respectively frontal and sagittal size/dimension of the bodies of vertebra. At the level of the II lumbar vertebra the relation of the sizes/dimensions of spinal canal and body of vertebra indicated

comprises approximately/exemplarily for frontal 1:2, for the sagittal ones - 1:3.

As the second reference point served joint extensions and roots of the small arcs of vertebrae. The lines, which pass immediately towards the inside from the roots of the small arcs (at the level of upper neck vertebrae, somewhat going for them), seen in the front X-ray photograph, comprise the lateral boundaries of spinal canal, and the line, which passes somewhat toward the front from the projection of the posterior body surface of vertebrae, it corresponds to the approximately/exemplarily front/leading boundary of this canal. Representation about the posterior boundary of spinal canal give joint extensions. At the level of neck vertebrae the heads of joint extensions in the profile X-ray photograph occur approximately/exemplarily to the middle of spinal canal. Beginning from the thoracic vertebrae, the projection of the articular extensions gradually begins to be moved toward the rear; so, at the level of average/mean thoracic vertebrae the posterior wall of spinal canal is passed immediately behind the joint extensions, and at the level of lumbar vertebrae - somewhat in front from them. For the alignment can serve also intervertebral apertures. On profile X-ray picture in the neck division the intervertebral apertures occur approximately/exemplarily to front/leading third of spinal canal, in the thoracic division - to middle third and in the lumbar - again to



front/leading third.

In the accompanying schematic figures (Fig. 91 and 92) dotted line designated the projection of spinal canal for the average/mean thoracic division of spine respectively in the front and profile X-ray photograph.

Important data for the recognition of the ratio of foreign body to the spinal canal provide also character/nature and localization of bone changes.

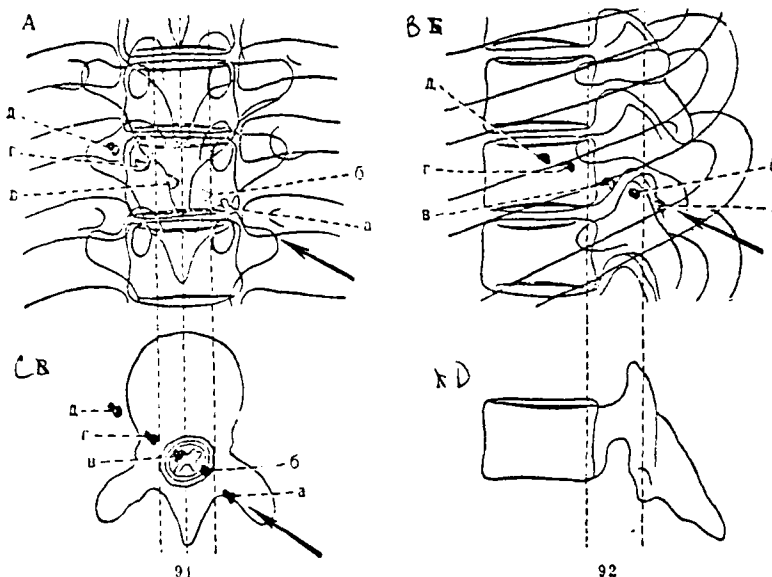


Fig. 91 and 92. Scheme of the front and profile X-ray photograph of spine. Explanation in the text.

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During the study of the front X-ray photograph of spine it is necessary to consider: 1) the disposition of inlet with respect to the line of awned extensions (to the right, to the left, on the line of extensions); 2) the position/situation of foreign body with respect to the same line (i.e., it did not reach this line, it is arranged/located on it or it changed it); 3) protrudes it to the vertebra or out of it and 4) what divisions of vertebra are

destroyed. The value of the account of these all moments/torques, especially first three, for the recognition of the ratio of foreign body to the spinal canal illustrates Fig. 91 (A, B).

The foreign bodies, which were advancing, to the left and upward of the inlet, situated to the right of awned islets, on the front X-ray photograph can prove to be arranged/located in any of the indicated on it positions/situations. Foreign bodies b and c project towards the inside from the dotted lines, i.e., to the spinal canal, and therefore they can be arranged/located in it; remaining three foreign bodies project out of the spinal canal and therefore they cannot be arranged/located in it. In this case body a as not reached the canal has to it no relation, whereas bodies d and e changed for the line of extensions and, therefore, we could cross canal.

During the analysis of profile X-ray photograph should be also considered the disposition of inlet and the projection of foreign body with respect to the spinal canal (Fig. 92C, D). Foreign body a undoubtedly is arranged/located out of the spinal canal, since, moving from behind and forward, it did not achieve the line, which passes behind the heads of joint extensions. Bodies b and c project to the spinal canal and can therefore be located in its lumen. In order to refine their relation to the latter, it is necessary to turn to the front X-ray photograph. Since in the front X-ray photograph

these bodies project to the spinal canal, then they undoubtedly are found in it (Fig. 91). Further analysis of both X-ray photographs shows that body c it moved along the canal up to the larger distance (in the front X-ray photograph it changed with respect to the inlet for the center line of body), than body b, and therefore it must apply to spinal cord the larger damage than the latter one which was delayed immediately after penetration into the canal.

Bodies d and e, projecting in the profile X-ray photograph to the body of vertebra, can be found both in it very and outside it. The comparison of these data with the data of the front X-ray photograph shows that body d is located in the body of vertebra, and body e - outside it. But both these foreign bodies, if we consider the position/situation of their and inlet (to the right of the line of awned extensions), could traverse the spinal canal and apply the straight/direct damage to spinal cord. For deciding/solving this question important value have radiographic indications of the damage of small arc or joint extensions. In the presence of damages their foreign bodies had to traverse the spinal canal. If convincing indications of the damage of these divisions of vertebra are absent, then about the passage of the foreign bodies through the spinal canal it is possible with the known fraction/portion of likelihood to conclude, having mentally reduced the projection of wound canal taking into account the position/situation of foreign bodies and

inlet.

In figure B the position/situation of all foreign bodies is represented in the horizontal sectional view through the vertebra and the spinal cord; in figure D - in the sagittal section of vertebra.

Experiment/experience showed that the method of the recognition of the ratio of foreign bodies presented to the spine and the spinal canal, which does not claim to the absolute accuracy, in practice proved to be highly useful.

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Differential diagnosis of contusion and wound of spinal cord.

It was above indicated that by the basic clinical forms of the damage/defeat of spinal cord with the penetrating wounds of spine are the contusions also its crushing (through the undamaged/uninjured solid cerebral shell) and wounds combat shell or bone fragment, which opened the latter; in the significant part of the cases the wound of spinal cord is combined with its contusion.

The experience, accumulated in the Great Patriotic War, makes it possible with the large fraction/portion of probability to

differentiate these two basic forms of the damages of the spinal cord with the penetrating wounds of spine.

The most reliable symptoms of the wound of spinal cord they are: 1) liquorrhea, which indicates the damage of solid cerebral shell; 2) with the perforating wounds of spine - intersection of spinal canal with combat shell close to the diameter of the latter (I type of the wound of spine); 3) blind-end wound with the occurrence of foreign body in the spinal canal (II type of the wound of spine).

The probability of the wound of spinal cord with blind wounds of spinal canal is very great. It was above indicated that in the cases of the blind-end bullet wounds of spinal canal checked the damage of solid cerebral shell occurred into 62.50/o, and with the fragmentation ones - into 80.00/o. However, the violation of the integrity of solid cerebral shell was usually conjugated with the wound of the substance of spinal cord or rootlets of horse tail. With the blind-end wounds of spinal canal important data for the recognition of the wound of spinal cord, independent of the sizes/dimensions of the wounding shell, gave estimation of the depth of its movement from the place of entry into the spinal canal to the place of occurrence in it. The further from the place of penetration in the canal moved the foreign body and the more its route/path approaches a middle section of canal, the greater the probability of

the wound of brain.

Tendency toward differentiation of wounds and contusions of spinal cord is justified not only by theoretical, but also practical considerations. With the wounds of spinal cord, in view of the violation of the integrity of solid cerebral shell, the danger of the development of severe infectious complications in its substance and shells is considerably higher than with the contusions. If the occurrence of foreign body in the spinal canal was indisputable leading to laminectomy, then with its occurrence in the substance of spinal cord surgical intervention not only was indisputably shown, but it one ought not to have produced as early as possible. Being arranged/located in the substance of spinal cord, it supported reactive edema and disorder of blood circulation in the adjacent with it divisions of spinal cord and complicated the plotted/applied to it damage. Moreover, it was the source of the development of suppurative myelitis or abscess in the spinal cord.

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Neurologic syndromes of the late period of wounds and damages of spine.

As noted in the general/common/total unit, the clinical picture of contusions and wounds of spinal cord in the sharp/acute and early period was sufficiently uniform. In essence it was evinced by the

partial or full/total/complete violation of the conductivity of spinal cord. During the partial violation of conductivity all functions during the first days on both halves body were usually disrupted more or less evenly. But subsequently, in proportion to the disappearance of the disorders, connected with the reversible changes in the spinal cord and its rootlets, gradually were revealed/detected as the residual ones the multifeature combinations of symptoms.

Most frequently among the residual conditions was noted the clinical picture of the diffuse cross damage/defeat of the spinal cord of different severity - from the light paresis to full/total/complete paralysis (39.90/o of all issues). In the cases of paraparesis motor disorders more frequently occurred asymmetric, i.e., they predominated on one side. Brown-Sekar syndrome was observed into 15.10/o of all wounds of the neck division of spine and into 3.00/o of wounds of thoracic division. Rarely were observed the syndromes of the combined sclerosis.

But, together with these syndromes, were observed such, with which in peacetime we usually did not meet. To this fact was turned the attention already in the first world war. Are most characteristic of them the following.

Syndromes of spinal hemiplegia or hemiparesis. With the high



wounds of the neck division of spine, together with the typical Brown-Sekar syndrome, sometimes were observed motor and sensitive disorders on one and the same half body. In the sharp/acute period usually occurred partial or full/total/complete paralysis of all four extremities, with the delay of urine and by the violation of all forms/species of sensitivity (Fig. 93).

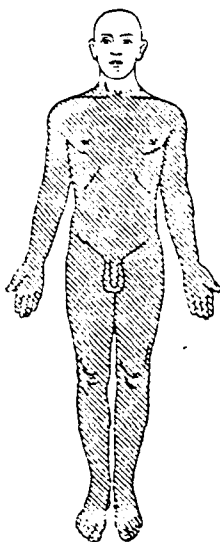


Fig. 93.

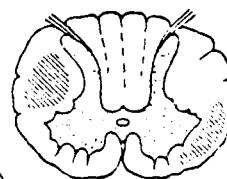
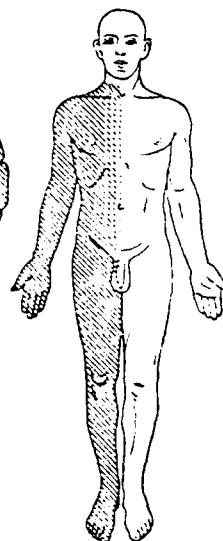
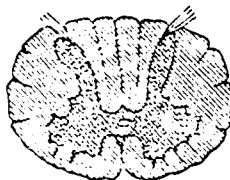


Fig. 94.

Fig. 93. Blind fragmentation nonpenetrating wound of neck division of spine at the level of IV neck vertebra. In the sharp/acute period paralysis of right extremities and almost full-left. The gross violation of all forms/species of sensitivity from the fourth neck segment is below, the delay of urine and feces. Focus occupies entire diameter of spinal cord.

Fig. 94. The same casualty in 4 months. Deep spastic paresis of right extremities with the violation of painful sensitivity on the same side of body. The functions of pelvic organs/controls are normal. At

the basis of syndrome two foci: in the posterior divisions of right lateral column and the similar/analogous half posterior column, and also in the front/leading divisions of left lateral column.

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In the final state motor and sensitive disturbances on one side were reduced completely, and on another - they remained disrupted. At the basis of syndrome lies/rests the damage on one side of the posterior division of lateral column and similar/analogous half posterior column, and on other - front-external division of lateral column (Fig. 94). As the final (residual) condition of the damage/defeat of spinal cord this syndrome more frequently was observed with unpenetrating wounds of spine. Its onset was conditioned, most probable, by the straight/direct damage of spinal cord on one side and on shock/counterblow on the contradictory/opposite.

Isolated/insulated spastic paralysis of both upper extremities. Immediately after wound appeared paralysis of upper extremities and paralysis or paresis of lower ones with more or less sharply pronounced violation of the sensitivity of conductor character/nature (Fig. 95). Subsequently motor disturbance in the lower extremities and conductor disorders of sensitivity disappeared, remained only spastic paralysis or groove of both upper extremities. At the basis

of syndrome there were fine/small necrotic foci or hemorrhages in the lateral columns at the level of the neck thickening, which border by thin layer gray substance on the boundary with the white (Fig. 96). With this localization the foci destroyed as corticospinal filaments to the upper extremities, so mainly their collaterals, which are guided toward the front/leading crescents.

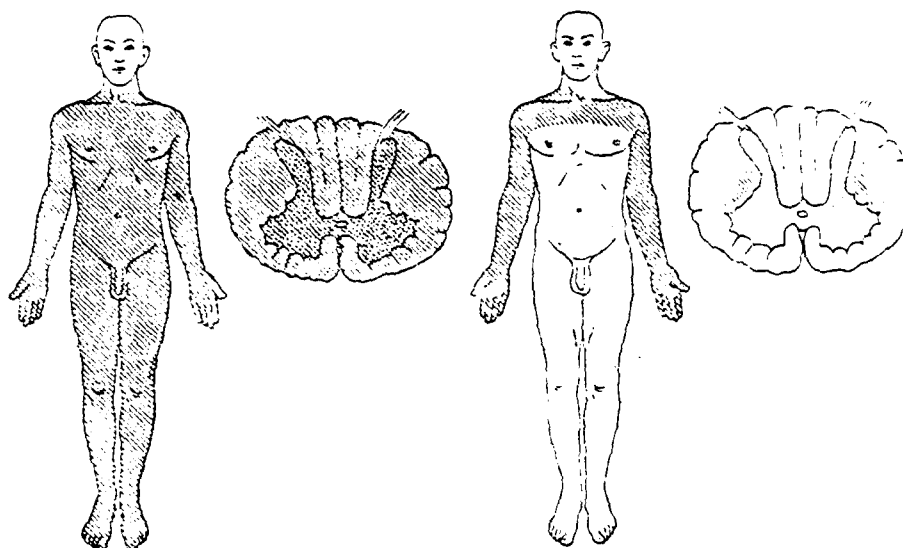


Fig. 95.

Fig. 96.

Fig. 96. Perforating bullet nonpenetrating wound of neck division of spine at the level of III neck vertebra. Immediately after wound paralysis of all four extremities, delay of urine and chair/stool, gross violation of sensitivity from the third neck segment. Focus occupies entire diameter of brain.

Fig. 96. The same casualty after 1 1/2 months. a deep spastic paresis of upper extremities. In other respects without the evasions from the norm. At the basis of syndrome lie/rest two small foci in the form of the ridges in deep divisions of lateral columns.

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Reduced syndrome of Brown-Sekar. Together with the typical Brown-Sekar syndrome, in the final states rarely was observed its reduced form: spastic paresis or deep paralysis and fallout of the musculoarticular feeling on one side, but without the noticeable violation of painful and temperature sensitivity on opposite side. Pathological focus in these cases captured the posterior division of lateral column, leaving free the anteroexternal division its, and corresponding half posterior column.

Front/leading lateral syndrome. In the sharp/acute period deep paraparesis with the heavy violation of sensitivity. In the final states is roughly disrupted on one side only painful and temperature sensitivity. Syndrome was observed rarely (Fig. 97 and 98).

Posterior dissociated syndrome. In the final states remained spastic paraparesis and violation of a musculoarticular feeling with the full/total/complete state of preservation or the insignificant disorder of painful and temperature sensitivity. It was observed mainly during the damages of the posterior semiring of spinal canal, in particular, when the wounding shell slipped along the awned

extensions or hit into the small arc of vertebra, being found on the end of flight. During the damages/defeats of the small arcs of neck vertebrae the final states were sometimes limited only to the gross violation of the musculoarticular feeling as a result of damaging the posterior columns. the cases of this genus described R. A. Golubov, Yu. V. Vasilenko et al.

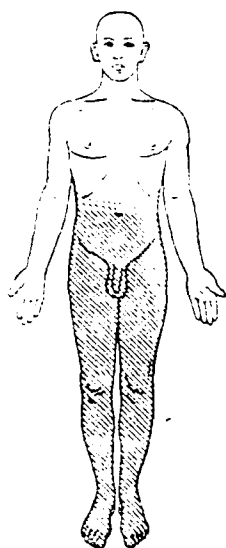


Fig. 97.

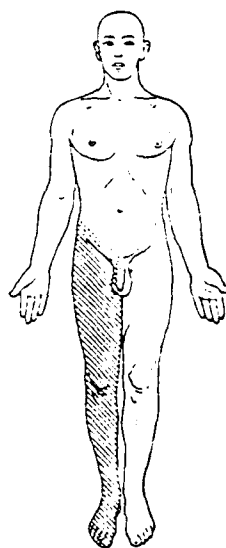


Fig. 98.

Fig. 97. Blind-end bullet nonpenetrating wound at the level of VII thoracic vertebra. Immediately after wound paralysis of lower extremities, numbness of body from the level of navel, delay of urine. Focus covers entire diameter of spinal cord.

Fig. 98. The same casualty in 5 1/2 months. All functions were reduced completely, with exception of the sharp weakening of painful and temperature sensitivity on right lower extremity, including latter/last sacral segments. Small focus in the front/leading division of left lateral column.



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Considerably more rarely was observed the front/leading dissociated syndrome with which in the final states to the foreground advanced conductor character/nature the violations of painful and temperature sensitivity or only by one of them in the absence or weak manifestation of motor disorders and state of preservation of the musculoarticular feeling. Syndrome was observed comparatively rarely. In the sharp/acute period in these cases more frequently was noted the partial violation of the conductivity of spinal cord.

During the damages/defeats of the first two lumbar vertebrae original flaccid deep paraparesis or paralysis with the disorder of the functions of pelvic organs/controls sometimes was changed by the isolated/insulated violation only of the functions of the bladder, circulation, erection.

During the partial damages/defeats of horse tail initial paraplegia in the initial conditions was sometimes changed by the disorder of the motor and sensitive functions predominantly or exclusively only of one extremity. But sometimes on both extremities more or less isolated/insulated remained disrupted either only motor

functions (front/leading dissociated syndrome of horse tail), or only sensitive (posterior dissociated syndrome of horse tail). V. G. Lazerev the motor dissociated syndrome noted into 8.00/o of all cases of the damages/defeats of horse tail, sensitive - into 4.00/o. They noted, that during the damages/defeats of separate rootlets in the innervated by them unit of the territory occurred a deep violation of sensitivity, and in the remaining unit - insignificant.

Issues. Issues with the penetrating wounds of spine were considerably more heavily than with the nonpenetrating ones; thus, for instance, with the nonpenetrating wounds good issues occurred into 38.60/o, with the penetrating wounds good issues were noted altogether only into 5.00/o (Table 29). Especially heavy issues were observed with the wounds of the thoracic division of spine. Good issues with these wounds are noted only into 3.40/o of observations.

From the analysis of the given numerals escape/ensue the following positions/situations:

1. The penetrating wounds of spine are extremely risky. Are especially risky the wounds of the thoracic division of spine.
2. Only in 5.00/o of casualties function was improved so, that provided state of preservation of ability to work. Most rarely

ability to work was reduced in those wounded the thoracic division of spina.

3. Issues in those wounded neck and lumbar division of spine were approximately/exemplarily identical.

Table 29. Issues of the penetrating wounds of spine general/common/total and for its basic divisions.

Отдел позвоночника	Трудо- способ- ность, восстано- влена	Трудо- способ- ность, ограни- чена	Прочие исходы	Всего
(1)	(2)	(3)	(4)	(5)
Шейный (6)	5,9	24,0	60,1	100,0
Грудной (7)	2,4	13,4	83,2	100,0
Пояснично-крестцовый (8)	6,9	23,1	60,0	100,0
Все отделы (9)	5,3	23,1	71,9	100,0

Key: (1). Division of spine. (2). Ability to work was reduced. (3). Ability to work is restricted. (4). Other issues. (5). In all. (6). Neck. (7). Thoracic. (8). lumbar- sacral. (9). All divisions.

Fig. 1-7.

The analysis of given in Table 10 fact shows that those survive 1  
of a group of penetrating wounds and the following 1/2 group of the  
survived/number of clinical issues of the affected division of  
wound. This, too, clinical issues in those survived after the wound  
of the thoracic division of spine was the level 1 1/2 times more  
than in those survived after the wounds of neck division.  
This, too, results after the wounds of thoracic  
division is explained by the fact that a large number of those  
wounded the thoracic division, besides, survive in absence the  
operation relatively not many/and details of brain. The number  
of those of the group with the wounds of a lumbar-sacral division  
of spine is comparable with the neck is explained by the  
circumstance that the reduction of the conductivity of the  
the finally the TV 1 received on the level 1/2 times more  
than in those of the group that the reduction of the conductivity of  
spinal cord.

Table 10. The number of those survived after the wounds of the spine.

living after the wound of neck division; on the whole they comprised 17.00% of the group of animals by 17.00% and 6.10% of those wound in the thoracic division and 6.10% - in those wound in the lumbar division.

In the group of paraplegia in the survey I after the wound of spine was on the whole small (3.70%). But this part/percentage of clinical issues sharply pre-dominant in those wound in thoracic division (4.00%) in comparison with those wound in lumbar- sacral division (2.10%) and especially those wound in neck (1.10%).

Issues of the form of paraplegia were more frequent, however in those survey I after the wound of thoracic and lumbar- sacral division. This part/percentage of issue was evenly equally in part/percentage 34.7 and 39.10%, whereas in those wound into the neck division it was noticeably below (26.70%).

Residual symptoms in the form of the motor paraplegia were equally was observed in those survey I after the wound of a in the sacral division.

Original treatment of the paraplegic animals of spine.

Results of the treatment were as follows.

In the majority of the cases of the above described wounds of this  
 was considered as no surgical intervention in the form of  
 debridement, drainage and periods of observation were found to be  
 sufficient for the treatment of wounds.

Table 3. Clinical picture after the penetration of an object into the spine (motor and proprioceptive violations) (in the case of various types of lesions).

(1) Степень повреждения	(2) Исходы								(11) Всего
	(3) Нормальный функционирование	(4) Монотетизм	(5) Броун-Секларов гемиплегический синдром	(6) Паралитический тетрапарез	(7) Монопарез	(8) Броун-Секларов синдром с нарушением чувствительности	(9) Паралитический гемипарез	(10) Синдром	
(12) Плечевой	20.9	3.0	3.6	1.2	14.6	11.5	26.7	13.5	100.0
(13) Грудной	34.2	1.0	—	9.0	5.0	3.0	38.7	9.1	100.0
(14) Пояснично-крестцовый	35.4	0.8	—	2.2	8.1	—	39.1	14.4	100.0
(15) Все уровни	31.3	1.3	0.8	3.7	7.6	3.7	36.2	12.4	100.0

Key: (1). Degree of lesion. (2). Results. (3). Normal functional. (4). Monotetism. (5). Brown-Seklov hemiplegic syndrome. (6). Paralytic tetraparesis. (7). Monoparesis. (8). Brown-Seklov syndrome with sensory impairment. (9). Paralytic hemiparesis. (10). Syndrome. (11). Total. (12). Cervical. (13). Thoracic. (14). Lumbosacral. (15). All divisions.

Table 4.

1. When a penetrating object of soft tissue enters the spine, there is a violation of conductivity of spinal cord and nerve root, which enters into 33.0% of cases. With this more frequently occurs a complete (total) complete interruption of conductivity of spinal cord and nerve root.

Taking into account the impossibility of the restoration of spinal cord in the present condition of full/cord/cord to anatomical description, unfortunately with this means of wound, with rare exception, it did not leave hopes for the restoration of the conductivity of spinal cord.

V. 2 April 17/11 1944 on combined perforating bullet penetrating wound of chest with the perforating penetrating wound of the spinal cord at the level of the thoracic vertebrae and the violation of the full/cord/cord violation of the conductivity of spinal cord at the level of the eleventh thoracic segment.

In the X-ray photographs is evident breaking in articulation interarticularis of the last root of skull and extension of the III thoracic vertebra. Breaking in of the right half skull and of the III thoracic vertebra in the posterior division and in particular with the separation of the lower right part of the skull. The skull fragments are displaced posteriorly. Spinal cord at this level is intact.

In view of the heavy condition cannot be operated at this level. The skull is carefully polished from bilateral compression. On the X-ray is observed the full/cord/cord violation of the conductivity of spinal cord at the level of wound. The gap/interval between the



one of spinal cord is filled with blood-containing fluid/light.  
 one of the spinal cord is visible in section of skull.

Only after the perforation, penetrating wounds of spinal cord  
 and skull fragments it was possible to see the individual signs of  
 a comparatively light damage of spinal cord. Description with the  
 results of the level of the horse skull was separated skull is clipped  
 off from the remaining skull, although in this case it is not a really  
 as damaged the part of spinal cord (Fig. 100).

2. Obtained 20/VIII 1944 the perforation skull - penetrating  
 wound of spinal cord - level of the III lumbar vertebra with the  
 evidence of the partial violation of the conductivity of roots of  
 horse tail and cone of spinal cord.

In the X-ray photographs is determined the break of the right  
 part of skull - level of the III lumbar vertebra. Oblique break of the  
 perforation of the skull of skull and to the left with the  
 displacement of the skull to the right part of skull and. Breaking is  
 the level of the level of the skull of the III lumbar vertebra with the  
 displacement of the skull fragments to the left and toward the rear.

10/10 (10/10) (10/10) (10/10) (10/10) (10/10) (10/10) (10/10) (10/10) (10/10) (10/10)  
 (10/10) (10/10) (10/10) (10/10) (10/10) (10/10) (10/10) (10/10) (10/10) (10/10)

position of horse tail. The coccyx, which was injured  
appeared/located in left and tail end of the dorsal sac, was  
on a level; coccyx located to the right and toward the front, in a  
position of 15° or 20° levels. After operation/procedure  
(a) (b) (c) (d) (e) (f) (g) (h) (i) (j) (k) (l) (m) (n) (o) (p) (q) (r) (s) (t) (u) (v) (w) (x) (y) (z) (aa) (ab) (ac) (ad) (ae) (af) (ag) (ah) (ai) (aj) (ak) (al) (am) (an) (ao) (ap) (aq) (ar) (as) (at) (au) (av) (aw) (ax) (ay) (az) (ba) (bb) (bc) (bd) (be) (bf) (bg) (bh) (bi) (bj) (bk) (bl) (bm) (bn) (bo) (bp) (bq) (br) (bs) (bt) (bu) (bv) (bw) (bx) (by) (bz) (ca) (cb) (cc) (cd) (ce) (cf) (cg) (ch) (ci) (cj) (ck) (cl) (cm) (cn) (co) (cp) (cq) (cr) (cs) (ct) (cu) (cv) (cw) (cx) (cy) (cz) (da) (db) (dc) (dd) (de) (df) (dg) (dh) (di) (dj) (dk) (dl) (dm) (dn) (do) (dp) (dq) (dr) (ds) (dt) (du) (dv) (dw) (dx) (dy) (dz) (ea) (eb) (ec) (ed) (ee) (ef) (eg) (eh) (ei) (ej) (ek) (el) (em) (en) (eo) (ep) (eq) (er) (es) (et) (eu) (ev) (ew) (ex) (ey) (ez) (fa) (fb) (fc) (fd) (fe) (ff) (fg) (fh) (fi) (fj) (fk) (fl) (fm) (fn) (fo) (fp) (fq) (fr) (fs) (ft) (fu) (fv) (fw) (fx) (fy) (fz) (ga) (gb) (gc) (gd) (ge) (gf) (gg) (gh) (gi) (gj) (gk) (gl) (gm) (gn) (go) (gp) (gq) (gr) (gs) (gt) (gu) (gv) (gw) (gx) (gy) (gz) (ha) (hb) (hc) (hd) (he) (hf) (hg) (hh) (hi) (hj) (hk) (hl) (hm) (hn) (ho) (hp) (hq) (hr) (hs) (ht) (hu) (hv) (hw) (hx) (hy) (hz) (ia) (ib) (ic) (id) (ie) (if) (ig) (ih) (ii) (ij) (ik) (il) (im) (in) (io) (ip) (iq) (ir) (is) (it) (iu) (iv) (iw) (ix) (iy) (iz) (ja) (jb) (jc) (jd) (je) (jf) (jg) (jh) (ji) (jj) (jk) (jl) (jm) (jn) (jo) (jp) (jq) (jr) (js) (jt) (ju) (jv) (jw) (jx) (jy) (jz) (ka) (kb) (kc) (kd) (ke) (kf) (kg) (kh) (ki) (kj) (kk) (kl) (km) (kn) (ko) (kp) (kq) (kr) (ks) (kt) (ku) (kv) (kw) (kx) (ky) (kz) (la) (lb) (lc) (ld) (le) (lf) (lg) (lh) (li) (lj) (lk) (ll) (lm) (ln) (lo) (lp) (lq) (lr) (ls) (lt) (lu) (lv) (lw) (lx) (ly) (lz) (ma) (mb) (mc) (md) (me) (mf) (mg) (mh) (mi) (mj) (mk) (ml) (mm) (mn) (mo) (mp) (mq) (mr) (ms) (mt) (mu) (mv) (mw) (mx) (my) (mz) (na) (nb) (nc) (nd) (ne) (nf) (ng) (nh) (ni) (nj) (nk) (nl) (nm) (nn) (no) (np) (nq) (nr) (ns) (nt) (nu) (nv) (nw) (nx) (ny) (nz) (oa) (ob) (oc) (od) (oe) (of) (og) (oh) (oi) (oj) (ok) (ol) (om) (on) (oo) (op) (oq) (or) (os) (ot) (ou) (ov) (ow) (ox) (oy) (oz) (pa) (pb) (pc) (pd) (pe) (pf) (pg) (ph) (pi) (pj) (pk) (pl) (pm) (pn) (po) (pp) (pq) (pr) (ps) (pt) (pu) (pv) (pw) (px) (py) (pz) (qa) (qb) (qc) (qd) (qe) (qf) (qg) (qh) (qi) (qj) (qk) (ql) (qm) (qn) (qo) (qp) (qq) (qr) (qs) (qt) (qu) (qv) (qw) (qx) (qy) (qz) (ra) (rb) (rc) (rd) (re) (rf) (rg) (rh) (ri) (rj) (rk) (rl) (rm) (rn) (ro) (rp) (rq) (rr) (rs) (rt) (ru) (rv) (rw) (rx) (ry) (rz) (sa) (sb) (sc) (sd) (se) (sf) (sg) (sh) (si) (sj) (sk) (sl) (sm) (sn) (so) (sp) (sq) (sr) (ss) (st) (su) (sv) (sw) (sx) (sy) (sz) (ta) (tb) (tc) (td) (te) (tf) (tg) (th) (ti) (tj) (tk) (tl) (tm) (tn) (to) (tp) (tq) (tr) (ts) (tt) (tu) (tv) (tw) (tx) (ty) (tz) (ua) (ub) (uc) (ud) (ue) (uf) (ug) (uh) (ui) (uj) (uk) (ul) (um) (un) (uo) (up) (uq) (ur) (us) (ut) (uu) (uv) (uw) (ux) (uy) (uz) (va) (vb) (vc) (vd) (ve) (vf) (vg) (vh) (vi) (vj) (vk) (vl) (vm) (vn) (vo) (vp) (vq) (vr) (vs) (vt) (vu) (vv) (vw) (vx) (vy) (vz) (wa) (wb) (wc) (wd) (we) (wf) (wg) (wh) (wi) (wj) (wk) (wl) (wm) (wn) (wo) (wp) (wq) (wr) (ws) (wt) (wu) (wv) (ww) (wx) (wy) (wz) (xa) (xb) (xc) (xd) (xe) (xf) (xg) (xh) (xi) (xj) (xk) (xl) (xm) (xn) (xo) (xp) (xq) (xr) (xs) (xt) (xu) (xv) (xw) (xx) (xy) (xz) (ya) (yb) (yc) (yd) (ye) (yf) (yg) (yh) (yi) (yj) (yk) (yl) (ym) (yn) (yo) (yp) (yq) (yr) (ys) (yt) (yu) (yv) (yw) (yx) (yy) (yz) (za) (zb) (zc) (zd) (ze) (zf) (zg) (zh) (zi) (zj) (zk) (zl) (zm) (zn) (zo) (zp) (zq) (zr) (zs) (zt) (zu) (zv) (zw) (zx) (zy) (zz)

Based on materials of Leningrad front, only 35.7% of  
patients with wounds of spine at the level of horse tail  
were treated by the operation of the full/total/compleat  
violation of its conductivity: into 64.3% clinically it was  
not possible to restore the conductivity/paralyzing the  
conductivity of spinal roots of horse tail.

1. With clinical-paralyzing wounds of spine violation of  
full/total/compleat violation of conductivity of spinal cord is noted  
in 44.3% of cases. The severity of the damage of spinal cord or  
partial of horse tail with this type of wound is based on a number  
of factors and first of all from the value of foreign body, direction  
of wound, level and localization of foreign body.



FIG. 10. Deformed; large motion picture of spine at the level of the VIII thoracic vertebra. Anatomical illustration of the spine and pelvis by its bone fragments. Preparation VII No. 10. Author of L. W. P. 1914, 1915.

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FIG. 101

Page



FIG. 101. Perforating fragmentation wound of spinal cord at the level of the 10th thoracic vertebra. (From Vol. V. of 1947 V).



by the vertebrae shell, moreover the latter usually was broken & moved to the side, leaving only separate ones of them (Fig. 102).

1. Obtained 30/XI 1943 the spinal bullet penetrating wound of horse at the level of the IV lumbar vertebra with the syndrome of the partial violation of the conductivity of spinal cord of horse tail.

In the X-ray photographs it is visible that the bullet still is located in the spinal canal through the left half of the posterior laminae of shell and on the IV lumbar vertebra, after continuing its lower-internal sector (some fragments were displaced towards the front and down) it passed into the area of spinal canal lower and on the right and was stopped in the right half spinal canal at the level of I sacral vertebra. Vertical break in shell etc of the V lumbar vertebra on the left from the lateral extension.

30/XII (on the 7th day after wound) - horse empty. With the operation procedure is discovered the break of shell and joint extensions of the IV and V lumbar vertebra to the left. Some bone fragments were incorporated in the spinal space and were arranged around the middle of horse tail. From the forchamber of lumbal sacra is extracted rifle bullet. Damages with the trauma turned out to be only two posterior roots. Suture the suture of wound.

was vaginally at 1 1/2 months with no light myelomeres in the  
 limits of lower-sacral segments, without the motor failures. Function  
 of pelvic organs/controls it was reduced completely.

In the fertilization of neurones to surgical intervention in the  
 only period with no spinal and pelvic neurones, neurones of spinal and  
 neurones of lower neurones, majority only type. One should also  
 mention that the neurones/distance of foreign body and non-fragments  
 of the substance of spinal cord and neurones of horse tail within the  
 neurones is always connected with or more or less considerable  
 translocation of the substance of spinal cord and neurones, poor the  
 position of intergrowth and curvings of the neurones, which  
 is not favorable for sign body.

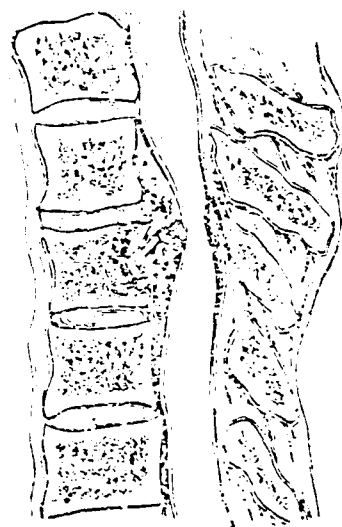


FIG. 101. Vertebral fragment, which comprises 5 or 6 vertebral bodies (sketches from the preparation).





Fig. 10. View of the surface of the object (Fig. 10. a).

Low view of the tail. The os pubis is shown in the lateral aspect of the tail. Various aspects of the vertebrae of spinal cord. The figure shows the location of the tail. Preparation V34 No 115. (The tail of a T. B. 12/1/14).

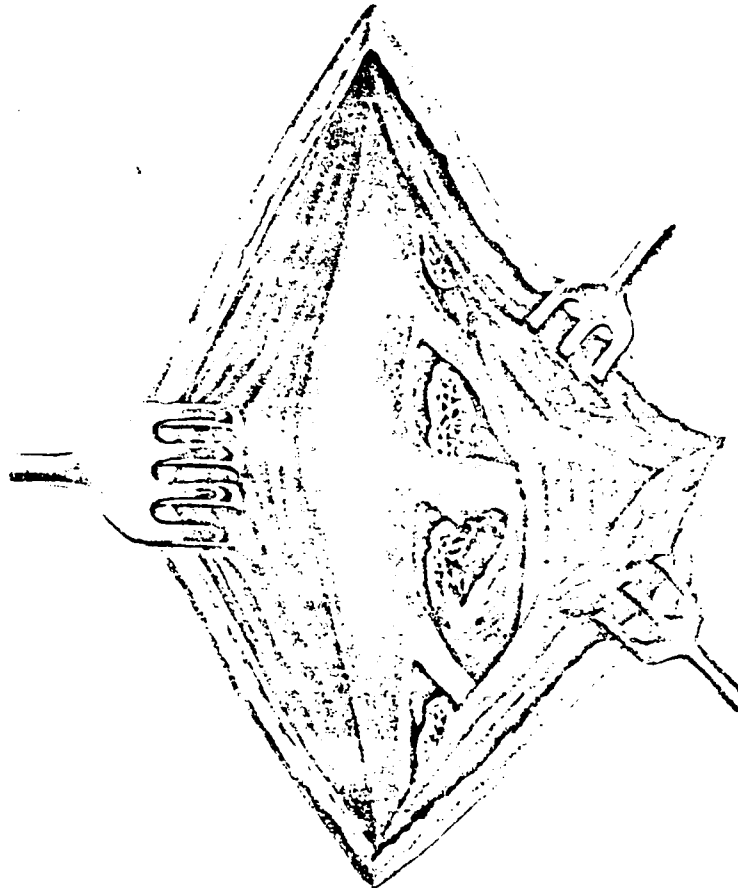


Fig. 100. The diamond shape in the illustration of the text.

Fig. 101. The diamond shape in the illustration of the text.

Fig. 102. The diamond shape in the illustration of the text.

Fig. 103.





conductivity of spinal cord with this form/species of wound is noted  
in 11.4 % of cases.

In 100% of the experiments/species of the spinal cord, the  
potential for testing, wounds of spine were most favorable, and  
concerned for early surgical intervention. With this means of work  
the wounds of all stages, on walls of spinal canal, showed a spinal  
cord, but it did not penetrate deepward it. Frequently in this case  
bone fragments were introduced in the spinal canal, causing the  
closure of spinal cord. In this case it was possible to establish  
that the bone fragments entered spinal canal and were rarely  
were observed it, penetrating the spinal cord or the roots of nerves  
and (Fig. 10. and 105).

P. obtained 13/11 1944 spinal cord section wound was when the  
potential penetration wound of spine at the level of the IV vertebra.  
Symptoms of partial restriction of the conductivity of  
spinal cord at this level.

Fig. 105.

At the level of the 5th vertebra, a complete paralysis of upper  
limbs, a complete paralysis of lower limbs, a loss of  
sensation and reflexes. The nature of all forms/species of

relatively free to fourth neck vertebra down, without any  
flexion.

At the last day the alternate insertion of urine, the last  
insertion of urine, in 10-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-100-101-102-103-104-105-106-107-108-109-110-111-112-113-114-115-116-117-118-119-120-121-122-123-124-125-126-127-128-129-130-131-132-133-134-135-136-137-138-139-140-141-142-143-144-145-146-147-148-149-150-151-152-153-154-155-156-157-158-159-160-161-162-163-164-165-166-167-168-169-170-171-172-173-174-175-176-177-178-179-180-181-182-183-184-185-186-187-188-189-190-191-192-193-194-195-196-197-198-199-200-201-202-203-204-205-206-207-208-209-210-211-212-213-214-215-216-217-218-219-220-221-222-223-224-225-226-227-228-229-230-231-232-233-234-235-236-237-238-239-240-241-242-243-244-245-246-247-248-249-250-251-252-253-254-255-256-257-258-259-260-261-262-263-264-265-266-267-268-269-270-271-272-273-274-275-276-277-278-279-280-281-282-283-284-285-286-287-288-289-290-291-292-293-294-295-296-297-298-299-300-301-302-303-304-305-306-307-308-309-310-311-312-313-314-315-316-317-318-319-320-321-322-323-324-325-326-327-328-329-330-331-332-333-334-335-336-337-338-339-340-341-342-343-344-345-346-347-348-349-350-351-352-353-354-355-356-357-358-359-360-361-362-363-364-365-366-367-368-369-370-371-372-373-374-375-376-377-378-379-380-381-382-383-384-385-386-387-388-389-390-391-392-393-394-395-396-397-398-399-400-401-402-403-404-405-406-407-408-409-410-411-412-413-414-415-416-417-418-419-420-421-422-423-424-425-426-427-428-429-430-431-432-433-434-435-436-437-438-439-440-441-442-443-444-445-446-447-448-449-450-451-452-453-454-455-456-457-458-459-460-461-462-463-464-465-466-467-468-469-470-471-472-473-474-475-476-477-478-479-480-481-482-483-484-485-486-487-488-489-490-491-492-493-494-495-496-497-498-499-500-501-502-503-504-505-506-507-508-509-510-511-512-513-514-515-516-517-518-519-520-521-522-523-524-525-526-527-528-529-530-531-532-533-534-535-536-537-538-539-540-541-542-543-544-545-546-547-548-549-550-551-552-553-554-555-556-557-558-559-560-561-562-563-564-565-566-567-568-569-570-571-572-573-574-575-576-577-578-579-580-581-582-583-584-585-586-587-588-589-590-591-592-593-594-595-596-597-598-599-600-601-602-603-604-605-606-607-608-609-610-611-612-613-614-615-616-617-618-619-620-621-622-623-624-625-626-627-628-629-630-631-632-633-634-635-636-637-638-639-640-641-642-643-644-645-646-647-648-649-650-651-652-653-654-655-656-657-658-659-660-661-662-663-664-665-666-667-668-669-670-671-672-673-674-675-676-677-678-679-680-681-682-683-684-685-686-687-688-689-690-691-692-693-694-695-696-697-698-699-700-701-702-703-704-705-706-707-708-709-710-711-712-713-714-715-716-717-718-719-720-721-722-723-724-725-726-727-728-729-730-731-732-733-734-735-736-737-738-739-740-741-742-743-744-745-746-747-748-749-750-751-752-753-754-755-756-757-758-759-760-761-762-763-764-765-766-767-768-769-770-771-772-773-774-775-776-777-778-779-780-781-782-783-784-785-786-787-788-789-790-791-792-793-794-795-796-797-798-799-800-801-802-803-804-805-806-807-808-809-810-811-812-813-814-815-816-817-818-819-820-821-822-823-824-825-826-827-828-829-830-831-832-833-834-835-836-837-838-839-840-841-842-843-844-845-846-847-848-849-850-851-852-853-854-855-856-857-858-859-860-861-862-863-864-865-866-867-868-869-870-871-872-873-874-875-876-877-878-879-880-881-882-883-884-885-886-887-888-889-890-891-892-893-894-895-896-897-898-899-900-901-902-903-904-905-906-907-908-909-910-911-912-913-914-915-916-917-918-919-920-921-922-923-924-925-926-927-928-929-930-931-932-933-934-935-936-937-938-939-940-941-942-943-944-945-946-947-948-949-950-951-952-953-954-955-956-957-958-959-960-961-962-963-964-965-966-967-968-969-970-971-972-973-974-975-976-977-978-979-980-981-982-983-984-985-986-987-988-989-990-991-992-993-994-995-996-997-998-999-1000-1001-1002-1003-1004-1005-1006-1007-1008-1009-1010-1011-1012-1013-1014-1015-1016-1017-1018-1019-1020-1021-1022-1023-1024-1025-1026-1027-1028-1029-1030-1031-1032-1033-1034-1035-1036-1037-1038-1039-1040-1041-1042-1043-1044-1045-1046-1047-1048-1049-1050-1051-1052-1053-1054-1055-1056-1057-1058-1059-1060-1061-1062-1063-1064-1065-1066-1067-1068-1069-1070-1071-1072-1073-1074-1075-1076-1077-1078-1079-1080-1081-1082-1083-1084-1085-1086-1087-1088-1089-1090-1091-1092-1093-1094-1095-1096-1097-1098-1099-1100-1101-1102-1103-1104-1105-1106-1107-1108-1109-1110-1111-1112-1113-1114-1115-1116-1117-1118-1119-1120-1121-1122-1123-1124-1125-1126-1127-1128-1129-1130-1131-1132-1133-1134-1135-1136-1137-1138-1139-1140-1141-1142-1143-1144-1145-1146-1147-1148-1149-1150-1151-1152-1153-1154-1155-1156-1157-1158-1159-1160-1161-1162-1163-1164-1165-1166-1167-1168-1169-1170-1171-1172-1173-1174-1175-1176-1177-1178-1179-1180-1181-1182-1183-1184-1185-1186-1187-1188-1189-1190-1191-1192-1193-1194-1195-1196-1197-1198-1199-1200-1201-1202-1203-1204-1205-1206-1207-1208-1209-1210-1211-1212-1213-1214-1215-1216-1217-1218-1219-1220-1221-1222-1223-1224-1225-122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The prolonged severe lesion of spinal cord (thoracic level), together with the contusion, led to the irreversible changes in the spinal cord. The fact that the tangential penetrating wound of spine operational observation as a rule, was considered in the early period shown, led to the fact that it was not special contraindications. With this means of wound the picture of the full/total/compl. violation of the conductivity of spinal cord was not contraindication to the further process in the early period.

At 13/I 1944 the spinal cord wound of lumbar region with the tangential penetrating wound of spine at the level of the 11-12 lumbar vertebrae. Symptoms of the full/total/compl. violation of the conductivity of spinal cord at the level of the 11-12 lumbar vertebrae.

After the admission into the hospital 13/I 1944 neurologic was determined flaccid paraplegia of lower extremities, fallout of all reflexes and sensitivity from the 11-12 thoracic segment down without the illumination, the urine and feces.

In the X-ray photographs: the lateral of small areas of the 11-12 lumbar vertebrae. The roots of small areas are not visible. An abscess will be to the right from the intervertebral aperture.



22/I (on the 4th day after wound) - laminectomy. Is discovered epidural hematoma and many fine/small bone fragments in the posterior division of spinal canal. Solid cerebral shell proved to be damaged in two places at the level of the II lumbar vertebra. Posterior lumbar (third) roots to the right proved to be interrupted. Into the defect of solid cerebral shell entered only xanthochromic cerebro-spinal fluid. After the removal/distance of bone fragments, hematoma and sewing up of the defects of solid cerebral shell the wound is in layers sewn tightly and healed by primary tension; on the 17th day after operation/process the casualty was evacuated into the rear in the satisfactory condition.

Through 3 1/2 years (1947) the sensitivity and the function of pelvic organs/controls completely were reduced. It walks with the bacillus/rod.

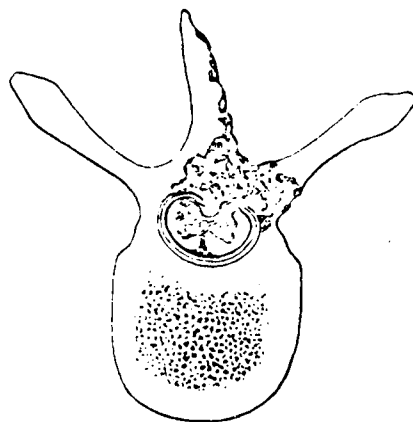


Fig. 104. The tangential penetrating wound of spine. Compression of spinal cord by bone fragments.



Fig. 105. Tangential penetrating wound of spine with the damage of spinal cord by bone fragments. Gap of soft cerebral shell.

Preparation VMM No 622.  
Artist of T. V. Belyayev.

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Summing up readings to surgical intervention with the penetrating wounds of spine, one should emphasize that as reliable, objective criterion for the judgment can serve a clinical-X-ray anatomical analysis of the course of wound canal in combination with the neurologic picture of wound upon consideration of the condition of wound and casualty.

1. With perforating penetrating wounds.

a). At the level of spinal cord when neurologic is defined syndrome of full/total/complete violation of conductivity of spinal cord, surgical intervention can carry only exploratory character/nature and be considered basically as preventive measure against suppurative processes without hope for reduction of functions of spinal cord.

b). At the level of horse tail with anatomical state of preservation of separate rootlets surgical intervention shown in

earliest possible periods, keeping in mind prophylaxis of infection, elimination of compression or retaining rootlets of horse tail by bone fragments, hematoma, etc.

Thus, in the presence at least they are minimum indications of the retention/preservation/maintaining of the conductivity of spinal cord or separate rootlets of horse tail operate one should possibly earlier.

2. With blind-end penetrating wounds.

a). In cases of wound by large/coarse foreign body, which perforates entire spine (or almost) spinal canal, radical surgical intervention it can pursue targets of prophylaxis of infection.

b). In cases of wound by foreign body of average value is shown early surgical intervention, in spite of syndrome of cross violation of conductivity of spinal cord, determined in this case in significant part of cases.

c). In cases of wound by very fin /small foreign body with localization of latter/fast in substance spinal cord with clinical phenomena of light damage, of latter surgical intervention is not shown. In the doubtful cases is shown exploratory laminectomy.

1). Foreign bodies, which are disposed of unit in spinal canal, rarely in intervertebral aperture, are subject to removal with appearing hemorrhage - it is urgent, in other cases - through 2-3 weeks.

3. With minimal penetrating wounds surgical intervention is shown in all cases, without depending on neurologic violations.

Excision is possible only for the wounds, which are escorted/tracked by insignificant bone damages without the expressed neurologic violations.

Internal/external/total lesions, to urgent surgical intervention with the penetrating wounds of spine is considerable liquorrhea, which escorts/tracks sometimes these wounds.

Are given below for the illustration statistical data based on materials of the neuro-surgical center of Leningrad Front, which can be compared to characteristic ones for the majority of neuro-surgical institutions GSR.

In the neuro-surgical center of Leningrad Front within the time

of the Great Patriotic War they underwent laminotomies 31.60/o of casualties with the penetrating wounds of spine, which in combination with 8.50/o of those operated in the preceding/previous stages (GBA) composes 40.10/o of all casualties with the penetrating wounds.

The characteristic of operational material and the periods of surgical intervention are given in Tables 31 and 32.

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From Tables 31 and 32 it is evident that most frequently laminectomy was conducted with the blind-end and tangential penetrating wounds. Solid carboxal shell was revealed into 37.80/o of all cases, and with the perforating penetrating wounds - even into 76.20/o. About the half those operated were subjected to intervention in the early periods, i.e., in the course of the first month after wound.

Table 31. On variability with different character/nature the distribution of wounds of spine (in the percentages).

(1) Механизм ранения	(2) Оперировано (по отношению ко всем ранениям данной группы)	(3) Твердая мозговая оболочка	
		(4) вскрыта-лась	(5) не вскрыта-лась
(6) сквозные проникающие ранения	11.5	76.2	23.8
(7) слепые проникающие ранения	45.4	59.8	40.2
(8) касательные проникающие ранения	28.2	12.9	87.1
(9) Всего	31.6	37.8	62.2

Key: (1). Mechanism of wound. (2). It is operated (with respect to all wounds of this group). (3). Solid cerebral shell. (4). it was revealed. (5). it was not revealed. (6). Perforating penetrating wounds. (7). Blind-end penetrating wounds. (8). Tangential penetrating wounds. (9). In all.



Table 32. Distribution according to the periods of operation/process (in the percentages).

(1) Срок операции (с момента ранения)	(2) Опериро- вано	(3) Твердая мозговая оболочка	
		(4) вскрыта- лась	(5) не вскрыта- лась
(6) До 1 недели	5.6	35.2	64.7
» 2 недель	9.4	42.4	57.6
» 1 месяца	31.2	42.2	57.8
(7) Больше 1 месяца	53.8	35.0	65.0
(10) Всего	100.0	37.8	62.2

Key: (1). Period of operation/process (from the moment/torque of wound). (2). It is operated. (3). Hard cerebral membrane. (4). revealed. (5). it was not revealed. (6). To 1 week. (7). weeks. (8). month. (9). It is more than 1 months. (10). In all.

Changes in a spirit and a spinal cord, detected on the operation/process.

The macroscopically detected on the operation/process changes depend on character/nature and mechanism of wound, and also on the periods of surgical intervention. During the study of the histories of the disease/sickness/illness/malady of different specialized neuro-surgical groups of reinforcing it was possible to detect the following:

1. The expressed traces supramembranal and submembranal hemorrhages were detected sometimes to one month and more after wound.

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However, more frequent after only one week after wound with the operation/process in submembranal space of the blood it was not detected even with the penetrating wounds of spine. From the analyzed observations it is possible to make the conclusion that tunicary hemorrhage (hematorrachis) have less vital importance in the clinic of the early period of the bullet wounds of spine, than this was considered earlier.

2. In presence of supramembranal and submembranal hemorrhages latter they were spread for considerable elongation/extent on length both in that ascending and in descending from level of wound direction. Is most distinctly hemorrhage is expressed in the epidural cellulose at the level of wound.

3. Intergrowth between membranes as consequence of hemorrhages or as product of organization processes, which take place according to type of productive inflammation, appeared usually only in intermediate and late period after wound (Fig. 106). However,

sometimes it was necessary to be encountered with the intergrowth, in particular, soft and arachnoid shell (arachnoiditis), already in the first week after wound.

4. Intergrowth of arachnoid shell were escorted/tracked by violation of liquor circulation, sometimes with accumulation of cerebro-spinal fluid between separate intersections and formation of false cysts, undoubtedly, that compress spinal cord or roots of horse tail (Fig. 107).

5. Intermembranal intergrowth were encountered both in restricted sector - in zone of greatest damage of spinal cord (arachnoiditis spinalis adhaesiva circumscripta) and disseminated along the length (arachnoiditis spinalis adhaesiva diffusa).

6. Density of joints between shells depended on character/nature of equalization, transferred hemorrhage or infection of membranes, and also on periods of intervention. Under conditions IBF it was possible to observe oscillations/vibrations from the tender intergrowth, easily divided when the operation/process fully, to remove submissively the intergrowth, divided with knife.

7. In spite of considerable ossific process, noted in zone of damage of spine already from 3-4th week after wound, nevertheless and

with intervention in 6-8 months and more (in spite of morphologically considerably expressed callus detected) it was to note mobility of separate bone fragments of small arc or extensions, damaged at moment of wound.

Thus, excess "callus", frequently conditioning the compression of spinal cord, does not nevertheless determine the actual consolidation of break. The latter fact forced: a) to the care in the operational technology with laminectomy in similar cases, b) to the prolonged immobilization of spine during the damages, which are escorted/tracked by the displacement of vertebrae (damage of disk and joints).

3. Depending on mechanism of wound, and also on direction of wound canal in frontal or sagittal plane of body and to a certain degree - from form/species and sizes/dimensions of wounding membrane and its manpower, with operation/process were detected diverse breaks of small arcs, bodies or apophyses of vertebrae with introduction of metallic and bone fragments at larger or smaller depth into spinal canal. Depending on the enumerated reasons it was possible to reveal/detect damage to 1-2-3 and more than vertebrae, and also different degree of the damage of spinal cord, its shells and nucleoli.

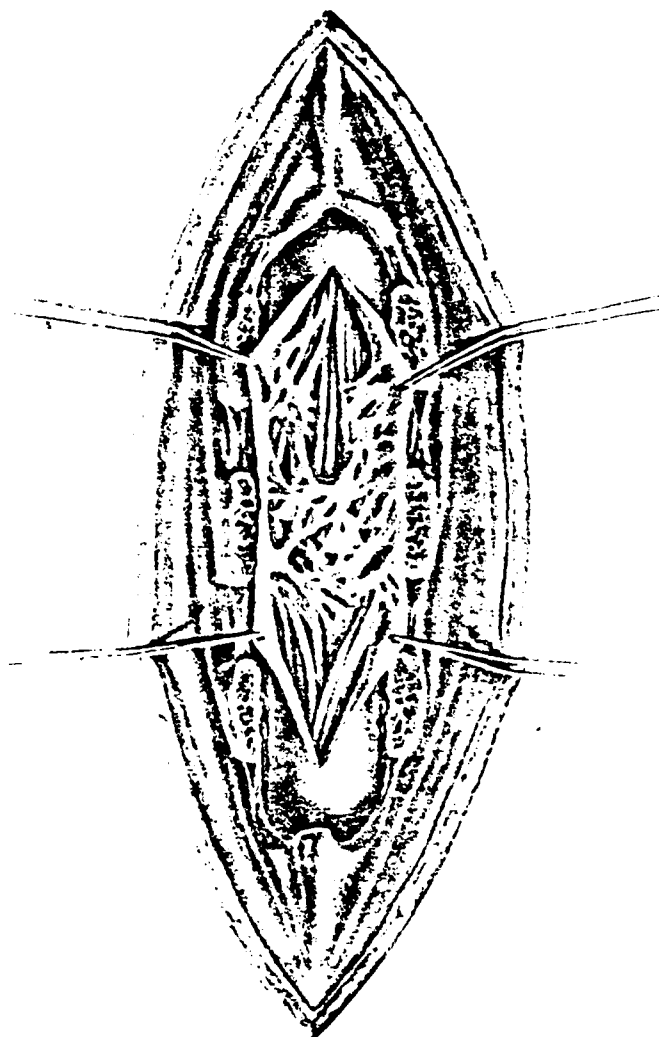


Fig. 100. Restricted adhesive arachnoiditis of the afterward  
tangential fragmentation penetrating wound at the level of horse  
tail. Bone fragments among the rootlets.

Observation of S. I. Brilyuk. (Artist of P. V. Silyayev.).

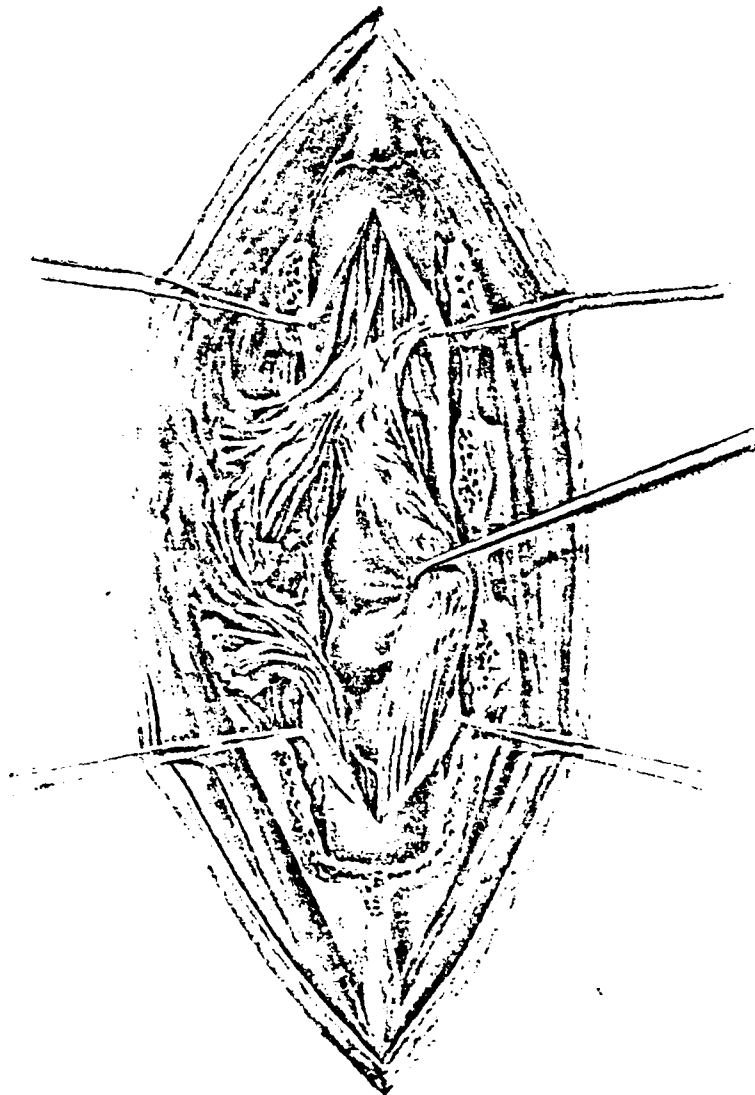


Fig. 107. Cystic arachnoiditis at the level of the horse-tail of the after-ward perforating penetrating fragmentation wound. Gap of the unit of the rootlets.

Observation of S. I. Drilyuk.

(Artist of P. V. Belyayev.).

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The full/total/complete anatomical interruption of spinal cord, with rare exception, it was noted only with the through, almost as a rule, the bullet penetrating wound of spine or with the blind-and penetrating wound by large/coarse foreign body.

Considerably more frequent on the operating table was detected the partial damage of spinal cord with the focus softening of its different extent both in the cross and lengthwise. This softening of spinal cord most frequently was noted with the blind-and penetrating wounds of spine with the localization of foreign body both subdural and it is epidural.

Softening spinal cord is the consequence not only of contusion, but also its compression with the corresponding violation of roof and liquor circulation. As the confirmation of this serve the foci of softening, discovered in a considerable number of cases with the tangential penetrating wounds of spine, with which bone fragments were arranged/located they extradurally and caused the compression of

spinal cord. This possibility experimentally demonstrated M. P. Postolov (1949).

In 41.60% of cases of the penetrating wounds, operated in one of the front line hospitals, bone fragments are discovered subdural, in the spinal cord or among the rootlets of the horse tail (discussion deals with the macroscopically visible fragments). As showed histological materials research of autopsies (A. A. Kulikovskaya) and the X-ray examination of the preparations of spinal cord (E. A. of Usponski), besides the seen with the naked eye fragments in the spinal cord, frequently was detected a considerable quantity of bone dust, scattered in the substance of spinal cord for the greater or smaller elongation/extent upwards and down from the main focus of damage.

With the wound at the level of horse tail the rootlets of the latter in the majority of the cases remained safe or partially damaged. In the single cases was only encountered the full/total/complete gap of all rootlets of horse tail with through or blind penetrating wound by large/coarse fragment.

For illustration of changes in spine and contents of spinal canal, detected on the operation/process, the knife are given thoroughly developed observations of one of the neuro-surgical



Hospitals GBF of Leningrad front, including 144 cases of laminectomy with different in the mechanism wounds of spine at its different levels are conducted within different periods after wound (Table 33).

Table 33. The changes, discovered in spine and contents of spinal canal depending on the periods of surgical intervention (in the absolute numerals).

(1) Сроки операции	(2) Гематомы	(3) Сращения				(4) Нагноения				(5) Остеомиелит	
		(6) Количество наблюдения	(7) эпидурально	(8) субдурально	(9) в раненом канале с костью	(10) арахноидно-паузные спаины	(11) арахноидально-паузные спаины	(12) рубцы в спинном мозгу	(13) в раненом канале		(14) субдурально
(16) До 1 месяца . . . .	73	8	4	55	15	1	1	6	—	—	1
(17) От 1 до 6 месяцев	71	—	—	67	32	4	4	5	2	2	5
(18) Всего . . . .	144	8	4	122	47	5	5	11	2	2	6

Key: (1). Periods of operation/process. (2). Hematomas. (3). Intergrowth. (4). Festerings. (5). Number of observations. (6). it is epidural. (7). it is subdural. (8). hard cerebral membrane with bone. (9). arachnoidal joints. (10). arachnoidal cysts. (11). scars in spinal cord. (12). in wound canal. (13). it is subdural. (14). in spinal cord. (15). Osteomyelitis. (16). To 1 months. (17). From 1 to 6 months. (18). In all.

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From Table 33 it is evident that in proportion to the distance of the period of operation/process grows/rises a quantity of intermembranal intergrowth, which are ruinously reflected in the function of spinal cord or rootlets of horse tail.

Operations/processes for convenience in their comparison on the periods of production are joined into two groups. However, it should be noted that indicated in Table 33 hematomas are discovered during the operation/process in the first 2 weeks after wound. The frequency of intersegmental intergrowth, on the contrary, gr-w/rose after this period, achieving the greatest manifestation 3 months after wound. It cannot be passed also past that fact that the arachnoidal intergrowth relatively more frequently were encountered with the blind-end penetrating wounds of spine.

Given data convincingly derive basis for early surgical interventions.

It is at the same time appropriate to cite data of S. I. Zidilyuk (1949), according to whom the author and after repeated radical laminectomy in time from 3 months to 2 years after the first nonradical operation/process obtained favorable outcome into 3/4 cases.

S. I. Zidilyuk to 28 repeated laminectomies in persons, acknowledged by invalids of the I group, revealed/detected pachymeningitis in 2 cases, metallic foreign bodies in the spinal

cord - in 5 cases, bone fragments in the spinal cord - in 6 cases.

Incidentally by it were produced also the emptying of cysts, the release of spinal cord, nuclei and rootlets from the intergrowth. As a result of these measures of 3 casualties they walk without the crutches and without the stick, 7 with crutches and without the apparatuses, 6 with walker, 8 patients can sit, they got rid of the spastic phenomena. In 5 wounded repeated operations/processes they proved to be unsuccessful.

Post-operation complications and issues of surgical treatment with the penetrating wounds of spine.

Most terrible complications after operations/processes apropos of the penetrating wounds of spine were the complications of infectious character/nature.

Based on materials of the development of the histories of the as-/sickness/illness/malady, after laminectomy in various stages of the vaccination, produced together with the primary surgical treatment of wound within different periods after wound, are noted the following purulent complications: festering operating wound - into 7.00% of cases, meningitis - into 9.70% and osteomyelitis - into 2.30% of cases.

According to the data of A. A. Kulikovskoy (GSF, 1943), death after operation/process in third of cases was conditioned on meningitis with the general/common/total operating lethality into 13.80%.

The frequency of suppurative post-operation complications depended on the period of intervention. Thus, according to the observations of A. A. Kulikovskoy on 42 laminectomies in the first 2 weeks were observed 3 suppurative complications, on 22 laminectomies on the 2-4th week - 3, on 54 laminectomies it is later than one month - 3, i. e., laminectomy to one month it was complicated by suppurative processes into 10.00% of cases and later than the month - into 5.50%. Logical to assume that in the first 1-2 weeks yet not have time to develop the joints between the shells which would impede the dissemination of infection in the ascending direction; correctly also the assumption that early surgical intervention can coincide in the time with the onset of spontaneous (wound) infection in the meninges.

The frequency of the post-operation complications of meningitis to a considerable extent depended both on the condition of wound, integrity of solid cerebral shell, virulence of infection and

resistivity of organism and on character/nature and surgical intervention technique.

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Thus, the autopsy of solid cerebral skull with the operation/process, it is doubtless, raises the danger of the outbreak of suppurative complications, in particular, meningitis.

The hence natural conclusion that with the operations/processes within the early periods, as is frequently under granulating conditions skull, solid cerebral skull can be opened only from the special readings (removal/absence of foreign bodies and bone fragments, hematoma, etc.).

Osteomyelitis after laminectomy, produced in all stages of evacuation, was, based on materials of the development of the histories of illness/sickness/illness/malady, it was noted into 2.30%. It is possible to assume that in a number of cases the onset of osteomyelitis is connected not so much with the operation/process, as with the character/nature of the damage of spine with the wound.

In connection with the expanded use/application of local anesthesia was lowered the frequency of complications of

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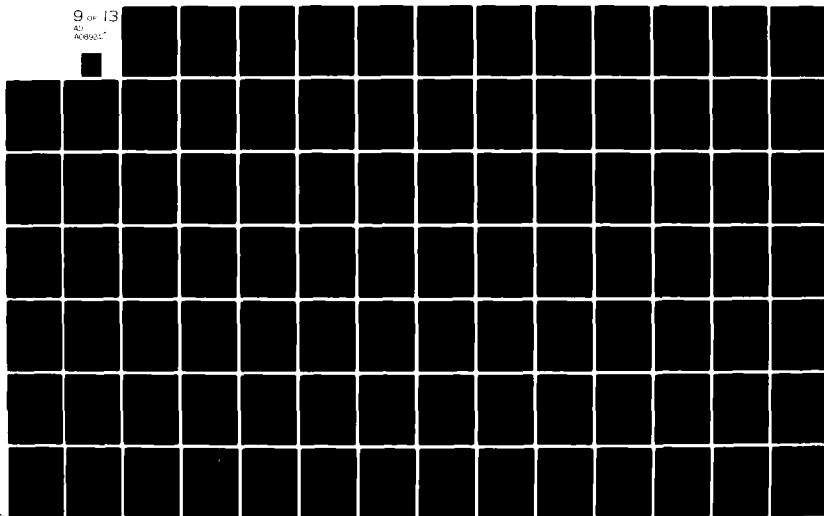
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operations/processes by pneumonia. According to the data of the development of the histories or disease/sickness/illness/malady, pneumonia after operation/process is noted into 2.40/o of cases; however, an essential effect on issue it did not have.

It is appropriate to give here the data about different suppurative complications with the penetrating wounds of spine after the primary surgical processing or the wound of different degree of radicality (Table 35).

On the basis Table 35 it would be erroneous to conclude that laminectomy with the penetrating wounds of spine is more risky, in view of the possibility of the complication of meningitis, than the dissection of wound with the removal/distance of bone fragments, or that the danger of the outbreak of osteomyelitis during the removal/distance of bone fragments is higher than during the simple dissection of wound. Here discussion deals with different contingents of casualties. Both laminectomy and dissection wounds with the removal/distance of bone fragments were conducted more frequently in the cases, different from those in which surgical processing was limited to simple dissection. Furthermore, most heavily casualties ~~died~~ <sup>died</sup>, without living to laminectomy and even to the onset of different infectious complications, as a result of the severity of wound and, in particular, the associated damage of vital internal



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organs/controls.

Nevertheless during the analysis of large material is completely obvious the advantage of the active and radical surgical therapy before the conservative or before the palliative dissection of wound.

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Table 34. Frequency of suppurative complications depending on the character/nature of surgical intervention and condition of solid cerebral shell (based on materials of the personal observations of I. Ya. Razdol'skiy) (in the absolute numerals).

(1) Состояние твердой мозговой оболочки и характер вмешательства	(2) Количество операций	(3) Количество гнойных осложнений
(4) Твердая мозговая оболочка не повреждена, при операции не вскрывалась . . . . .	52	2
(4) Твердая мозговая оболочка не повреждена, при операции вскрывалась . . . . .	13	2
(5) Твердая мозговая оболочка повреждена, при операции не вскрывалась . . . . .	3	2
(5) Твердая мозговая оболочка повреждена, при операции вскрывалась . . . . .	51	7
(6) Всего . . .	119	13

Key: (1). Condition of solid cerebral shell and character/nature of intervention. (2). Quantity of operations/processes. (3). Quantity of suppurative complications. (4). Solid cerebral shell is not damaged, with operation/process it was not revealed. (5). Solid cerebral shell is damaged, with operation/process it was revealed. (6). In all.

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This is confirmed by the comparison of the issues of the uncomplicated and complicated wounds of spine and spinal cord during the surgical and conservative treatment.

Under the complicated wounds should be understood the wounds,

which were being escorted/tracked by different complications of infectious and trophic-paralytic character/nature of uro-infection, bedsores, meningitis, etc.).

From Table 36 it is evident that the issues both of the complicated and uncomplicated wounds, are considerably better in those operated than in those not operated.

Special interest are of data of the issues of surgical treatment depending on the severity of the damage of spinal cord or horse tail.

Table 35. Frequency of infectious complications with the various forms of the primary surgical perfecting of the penetrating wounds of spine (based on materials on the development of the histories of disease/sickness/illness/disease) (in the percentages).

(1) Осложнение	(2) Первичная хирургическая обработка				(7) Всего
	(3) рассече- ние раны	(4) рассечение раны с уда- лением костных осколков	(5) рассечение раны с уда- лением костных осколков и инородных тел	(6) ламинэк- томия	
(8) Нагноение раны . . . . .	13,8	11,3	15,7	7,6	12,9
(9) Столбняк . . . . .	0,7	—	—	—	0,1
(10) Анаэробная инфекция . . . . .	2,7	2,9	—	—	2,0
(11) Остеомиелит позвоночника . . . . .	6,4	17,6	9,5	2,8	6,9
(12) Абсцесс спинного мозга . . . . .	0,3	0,7	—	—	0,5
(13) Менингит . . . . .	7,4	5,6	7,5	9,7	7,7
(14) Другие (негнойные) ослож- нения . . . . .	31,5	34,2	29,6	50,0	35,8
(15) Не было осложнений . . . . .	37,2	27,8	37,7	29,9	34,1
(16) Всего . . . . .	100,0	100,0	100,0	100,0	100,0

Key: (1). Complication. (2). Primary surgical processing. (3). dissection of wound. (4). dissection of wound with removal/distance of bone fragments. (5). dissection of wound with removal/distance of bone fragments and foreign bodies. (6). laminectomy. (7). In all. (8). Festering wound. (9). Tetanus. (10). Anaerobic infection. (11). Osteomyelitis of spine. (12). Abscess of spinal cord. (13). Meningitis. (14). Other (nonpurulent) complications. (15). It was not complications. (16). In all.

Table 36. Issues of the complicated and uncomplicated wounds of spine and spinal cord in the unoperated and operated casualties (based on materials of the development of the histories of disease/sickness/illness/malady) (in the percentages).

(1) Исход	(2) Характер ранения и лечение	(3) Неосложненные ранения		(4) Осложненные ранения	
		(5) не опе- рированы	(6) опера- рованы	(7) не опе- рированы	(8) опера- рованы
(7) Восстановление трудоспособности . . . . .		21,7	31,5	8,1	17,1
(8) Ограничение трудоспособности . . . . .		26,6	35,6	20,0	38,8
(9) Прочие исходы . . . . .		51,7	32,9	70,9	44,1
(10) Всего . . . . .		100,0	100,0	100,0	100,0

Key: (1). Issue. (2). Character/nature of wound and treatment. (3). Uncomplicated wounds. (4). Complicated wounds. (5). they are not operated. (6). they are operated. (7). Reduction of ability to work. (8). Limitation of ability to work. (9). Other issues. (10). In all.

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From Table 37 it is evident that the full/total/complete anatomical interruption of spinal cord does not leave hopes for the reduction of ability to work even in the restricted measure, giving the fatal results into 96.10/o of cases. Groznyy remains functional prognosis, also, during the partial damage of spinal cord, although lethality after operation/process with this lower than in the

preceding/previous group.

Is somewhat better the prognosis of the surgical treatment of the penetrating wounds of spine with the damage of horse tail.

The issues of the surgical treatment of the penetrating wounds in the dependence on the periods of operations/processes are represented in Table 38.

Although the lethality with the operations/processes during the first 10 days is above, and the percentage of favorable outcome is equal or even somewhat lower than with the operations/processes, produced within the later periods, nevertheless the advantage of interventions in the early periods becomes obvious, if one considers that within the later periods underwent operation/process only the casualties, who survived the complications of early period.

Are in more detail represented the issues of the surgical treatment of the penetrating wounds in Table 39 based on materials of the neuro-surgical center of Leningrad Front, which cover 330 cases of laminectomies.

Table 37. Issues of the surgical treatment of the penetrating wounds of spine depending on severity the damage of spinal cord and horse tail (in the percentages).

(1) Характер неврологических нарушений	(2) Иссход	(3) Восстановление трудоспособности	(4) Ограничение трудоспособности	(5) Смерть	(6) Прочие исходы	(7) Всего
(8) Полный анатомический перерыв спинного мозга . . . . .		0,0	3,6	96,1	0,3	100,0
(9) Частичный анатомический перерыв спинного мозга . . . . .		4,7	42,2	52,0	1,1	100,0
(10) Повреждение конского хвоста . . .		4,4	54,7	37,9	3,0	100,0

Key: (1). Character/nature of neurologic violations. (2). Issue. (3). Reduction of ability to work. (4). Limitation of ability to work. (5). Death. (6). Other issues. (7). In all. (8). Full/total/complete anatomical interruption of spinal cord. (9). Partial anatomical interruption of spinal cord. (10). Damage of horse tail.

Table 34. Issues of the surgical treatment of the penetrating wounds in the dependence on the periods of surgical intervention (in the percentages).

(1) Срок лечения	(2) Иссечение	(3) Восста- новление трудоспо- собности	(4) Ограни- чение трудоспо- собности	(5) Смерть	(6) Прочие исходы	(7) Всего
(8) До 1 дня . . . . .		6,2	24,9	67,6	1,3	100,0
2-3-й день . . . . .	(9)	6,1	24,1	68,8	1,0	100,0
4-9-й день . . . . .	(10)	6,6	23,8	69,6	—	100,0
10-30-й день . . . . .	(11)	6,0	45,3	47,5	1,2	100,0
более 1 месяца . . . . .	(12)	5,6	48,6	40,1	5,7	100,0

Key: (1). Period of interventions. (2). Issue. (3). Reduction of ability to work. (4). Limitation of ability to work. (5). Death. (6). Other issues. (7). In all. (8). To 1 days. (9). day. (10). 10-30th day. (11). It is more than 1 months.

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From Table 39 it is evident that the best issues of operations/processes are obtained in those wounded into the neck division, somewhat worse in those wounded a lumbar-sacral division and it is still worse in those wounded the thoracic division of the spine with wounds of which more frequently were encountered the combined wounds. The extremely heavy form of the damage of spinal cord in the neck division under conditions GBF was encountered



exclusively rarely. And to the same degree clear the more favorable outcome of surgical interventions in the lumbar division, especially at the level of the horse tail whose rootlets frequently slip off from the wounding shell with the penetrating into the spinal canal wounds.

Most essential effect on the outcome of operation/process, as has already been communicated, is exerted the severity of the damage of spinal cord or its rootlets, that it is possible to see from Table 4).

Table 39. Issues of surgical treatment depending on the level of wound (based on materials of the neuro-surgical center of Leningrad Front) (in the percentages).

(1) Уровень ранения позвоночника	Исход (2)	(3) Восста- новление трудо- способ- ности	(4) Умерен- ное огра- ничение трудо- способ- ности	(5) Ограни- чение трудо- способ- ности с различ- ной сте- пенью инвалид- ности	(6) Смерть	(7) Всего
(8) Шейный отдел . . . . .		8,3	28,8	47,4	15,3	100,0
(9) Грудной " . . . . .		1,6	19,4	58,0	21,0	100,0
(10) Пояснично-крестцовый отдел . . . . .		7,7	21,7	53,8	16,8	100,0
(11) Всего . . . . .		6,4	22,8	53,4	17,4	100,0

Key: (1). Level of the wound of spine. (2). Issue. (3). Restoration of ability to work. (4). Moderate limitation of ability to work. (5). Limitation of ability to work with different by degree of incapacitation. (6). Death. (7). In all. (8). Neck division. (9). Thoracic. (10). Lumbar-sacral division. (11). In all.

Table 40. The issues of the surgical treatment of the penetrating wounds in the hip along on the severity of the damage of spinal cord or horse tail (based on materials of the neuro-surgical center of Biological Front) (in the percentages).

(1) Тяжесть поврежде- ния нервной системы	(2) Исход	(3) Восста- новление трудо- способ- ности	(4) Умерен- ное огра- ниче- ние трудо- способ- ности	(5) Ограни- чение трудо- способ- ности с раз- лич- ной сте- пенью инвалид- ности	(6) Прочие исходы	(7) Всего
(8) Частичный анатомический перерыв спинного мозга . . . . .		1,7	8,3	76,7	13,3	100,0
(9) Контузия и компрессия спинного мозга . . . . .		10,7	42,9	37,5	8,9	100,0
(10) Повреждение конского хвоста с кон- тузией конуса спинного мозга . . . . .		—	2,5	70,0	27,5	100,0
(11) Частичное повреждение и контузия конского хвоста . . . . .		11,3	33,7	46,0	9,0	100,0
(12) Всего . . . . .		6,4	22,8	53,4	17,4	100,0

Key: (1). Severity of the damage of the nervous system. (2). Issue. (3). Restoration of ability to work. (4). Moderate limitation of ability to work. (5). Limitation of ability to work with different degree of disability. (6). Other ascends. (7). In all. (8). Partial anatomical interruption of spinal cord. (9). Contusion and compression of spinal cord. (10). Damage of horse tail with contusion of cone of spinal cord. (11). Partial damage and contusion of horse tail. (12). In all.

From the data of Table 40 it is evident that even with the partial anatomical interruption of spinal cord the prognosis in the sense of reduction by function is represented in the sufficient measure by terrible, to say nothing of the cross interruption of spinal cord.

Doubtful to the same degree remains functional prognosis, also, for the casualties with the damage of horse tail in combination with the damage of the core of spinal cord, although the lethality in the near-st issues in this group of casualties is comparatively small, the survived casualties, almost as a rule, they remain invalids. Attention is drawn to lower lethality in those operated in the neuro-surgical center of Leningrad Front GSF in comparison with the data, obtained based on materials of the development of the histories of dis as /sickness/illness/malady. To explain this is possible by the fact that on GSF entered somewhat less heavily casualties. It is not possible to disregard operations/processes, and also condition technique of departure/attendance which in the specialized hospitals GSF could be better.

The best issues are obtained in those operated apropos of contusion and compression of spinal cord, and also during the partial damage of roots of horse tail, especially with the operation/process within the early periods after wound (Table 41).

From Table 41 it is evident that the most favorable results are obtained in casualties, operated into first 2, week after wound. In casualties, operated on the 3rd week and to a lesser degree on the 4th week after wound, is obtained also a considerable number of favorable functional outcome, but with the operations/processes in these periods and lethality it proved to be doubly higher than in those subjected to operation/process in the first 2 weeks after wound. This increase in the lethality is explained, as has already been indicated above, by the fact that the 3rd and 4th week after wound they coincide with the period of the greatest development of early complications in casualties with the penetrating wounds of spine.

Table 41. Issues of the surgical treatment of the penetrating wounds in the dependence on the periods of surgical intervention (according to the data of the neuro-surgical center of Leningrad Front) (in the percentages).

(1) Срок операции	(2) Исход	(3) Восста- новление трудо- способ- ности	(4) Умерен- ное огра- ничение трудо- способ- ности	(5) Ограни- чение трудо- способ- ности с различ- ной сте- пенью инвалид- ности	(6) Смерть	(7) Всего
(8) До 1 недели		8,4	14,6	62,5	14,6	100,0
(9) От 1 до 2 недель		5,7	20,0	60,0	14,3	100,0
" 2 " 3 "		17,2	20,7	31,5	27,6	100,0
" 3 недель до 1 месяца (10)		6,3	18,8	42,7	31,2	100,0
" 1 до 2 месяцев (11)		7,8	25,5	51,0	15,7	100,0
" 2 " 3 "		—	33,2	53,4	13,3	100,0
Свыше 3 месяцев (12)		—	28,2	61,5	10,3	100,0
(13) Всего		6,4	22,8	53,4	17,4	100,0

Key: (1). Period of operation/process. (2). Issue. (3). Reduction of ability to work. (4). Moderate limitation of ability to work. (5). Limitation of ability to work with various degree of disablement. (6). Death. (7). In all. (8). To 1 week. (9). From 1 to 2 weeks. (10). weeks to 1 months. (11). to 2 months. (12). 1+ is more than 3 months. (13). In all.

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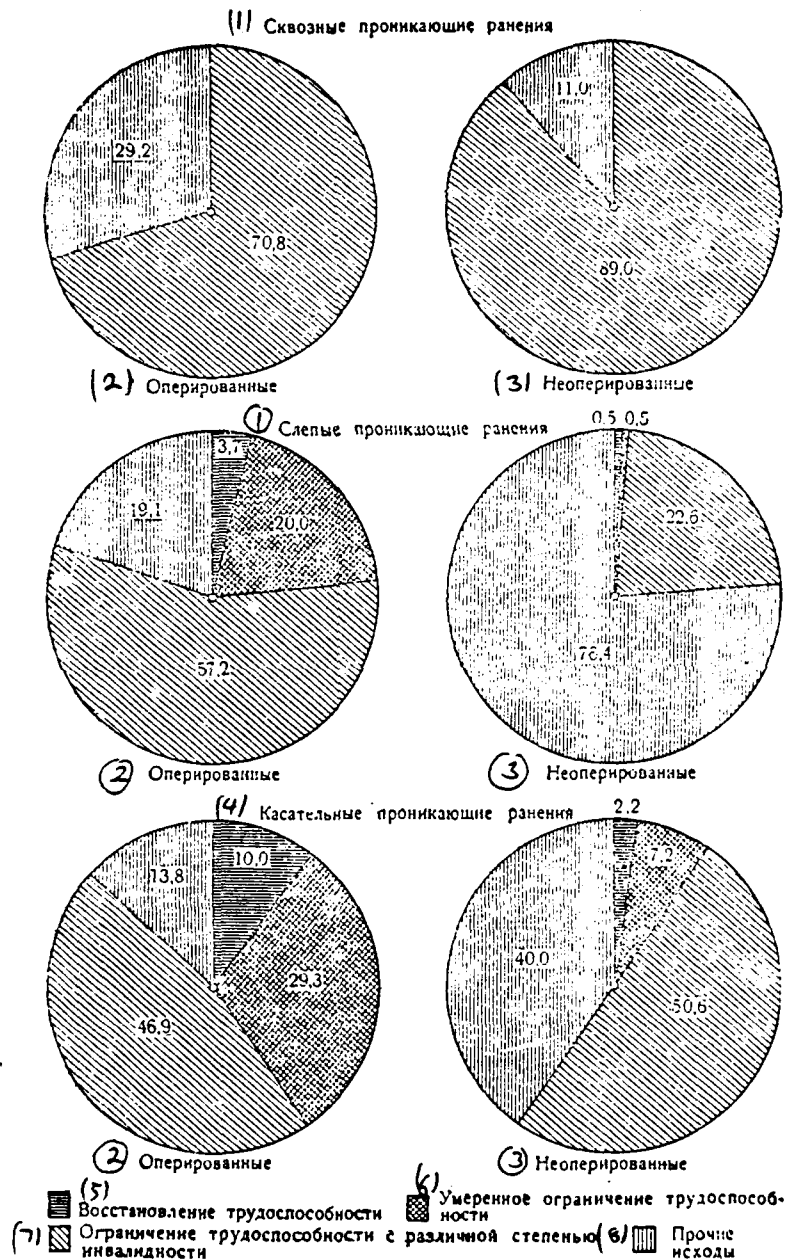


Fig. 103. Issues of penetrating wounds of spine in those operated and

not operated.

Key: (1). Penetrating wounds. (2). Operated. (3). Not operated. (4). Tangential penetrating wounds. (5). Reduction of ability to work. (6). Moderate limitation of ability to work. (7). Limitation of ability to work with different degrees of disablement. (8). Other issues.

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With the operations/processes within the later periods again descends the lethality among those operated together with a reduction in the frequency of vitally risky complications, but is decreased also a quantity of favorable functional outcome, especially in those operated at the end of the intermediate period (third month) and in the late period of wound.

The value of the form/species of the wounding shell for the issue of wound is completely indisputable. This can be seen from the comparison of the frequency or purulent of the complications after operation/process, which were being observed with the bullet and fragmentation wounds. This relationship/ratio is equal to 1:2.

The comparison of the issues of the surgical and conservative



to treatment of the bullet wounds of spine and spinal cord is difficult, since different methods of treatment were commonly used to different contingents of casualties.

According to the materials of the development of the histories of disease/sickness/illness/malady, are acquired following data (Table 42).

The advantage of surgical treatment is completely obvious during the comparison of data of reduction with the data of the limitation of ability to work during the conservative and surgical treatment.

According to given on the neuro-surgical center of Leningrad Front, the nearest issues of the penetrating wounds, depending on the applied treatment, are represented in Fig. 108.

Given data show the advantages of the active surgical treatment of the penetrating wounds of spine.

Table 42. Comparison of the issues of surgical and conservative treatment with different character/nature the penetrating wounds of spine (in the percentages).

(1) Механизм ранения	(2) Исслоз	(3)	(4)	(5)	(6)
		Восста- новление трудо- способ- ности	Ограни- чение трудо- способ- ности	Прочие исходы	Всего
(7) Сквозные:					
(8) оперированные		—	24,3	75,7	100,0
(9) неоперированные		0,5	5,8	93,7	100,0
(10) Сленые:					
(8) оперированные		0,8	50,0	49,2	100,0
(9) неоперированные		0,9	16,4	82,7	100,0
(11) Касательные:					
(8) оперированные		3,4	63,6	33,0	100,0
(9) неоперированные		8,2	27,8	64,0	100,0

Key: (1). Mechanism of wound. (2). Issue. (3). Reduction of ability to work. (4). Limitation of ability to work. (5). Other issues. (6). In all. (7). Throughs. (8). Operated. (9). not operated. (10). Blind. (11). Tangents.

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Chapter III.

Combined, associated and multiple wounds of spine and spinal cord.

Candidate of medical sciences docent D. G. Gol'dver.

Under combined wounds of spinal column one and the same shell there are affected adjacent organs/controllers and systems, for example, the wound of spine and organs/controllers of chest or abdominal area, spine and skull, etc.

The associated wounds of spine is called simultaneous wound by several fragments or shells of spinal column and other organs/controllers and systems.

Under the multiple wounds of spine is implied the simultaneous wound of spine by several fragments or bullets at the different levels.

Combined and associated wounds. The frequency of the combined and associated wounds of spine, including the combined wounds of the soft tissues of body and extremities, achieved 70.30/o with respect to all wounds of spine. The combined wounds of spine were heavier than isolated/insulated, their treatment is more complex, and prognosis is more serious. By the redoubling of the severity of the combined wounds it is possible to explain the fact that in the hospital net/system the relative frequency of the combined wounds of the spine and other organs/controls regularly descended in proportion to removal/distance from the front line.

Thus, without taking into account the combined wounds of soft tissues M. I. Grashchenkov (rear, 1943) met the combined wounds in 4.0-5.00/o all of those wounded the spine and the spinal cord, V. V. Pishchugin (GBF, 1943) 13.00/o, G. P. Korniyanskiy (GBF, 1943) 13.80/o, N. S. Kosinskaya (1946) 20.50/o (in 15.20/o - combination with the wound of chest and in 10.30/o - with the wound of the organs/controls of abdominal area). By the special s-verity of the combined and associated wounds should be explained also the relatively high frequency of the combined wounds, established/installed on the autopsies. Thus, according to L. I. Smirnov's sectional data (rear), the combined wounds of the spine and

other organs/controls are noted into 31.00/o of cases, ie. A. Usprinskiy (rear) - into 55.00/o, D. A. Kislova (SEG of front) - in 50.00/o, A. A. Kulikovskoy and D. G. Goldberg (GBZ, 1945) - in 50.20/o with 26.90/o of combined wounds with respect to all that wounded into the spine, that were being located undergoing medical treatment in this hospital.

Based on materials on the development of the protocols of autopsies and reports it fell, the ratio of the isolated/insulated wounds to those combined among the dead persons for all stages of evacuation is expressed as 1:4.

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The frequency of the combined wounds to a certain extent depends on the level of wound. Thus, based on materials of the development of the histories of disease/sickness/illness/malady, the frequency of the combined and associated wounds with the wound of the neck division of spine composed 67.30/o, with the wound of the thoracic division of the spine-72.70/o and lumbar- sacral - 66.80/o.

Into this number enter also combined wounds of the soft tissues of body and extremities without which the frequency of the combined wounds of the spine and other organs/controls for the levels of wound

is distributed as follows: with the wound of the neck division of spine -34.90/o, thoracic division of spine -52.70/o and lumbar-sacral division of spine -32.30/o. From the preceding information it is evident that the most frequently combined and associated wounds were observed with the wound of the thoracic division of spine, which is conditioned on the anatomical relations (is direct the biligence of chest) and on the extent of the thoracic division of spine.

In more detail the frequency of the combined and associated wounds of spinal column and different organs/controls in the comparison with the isolated/insulated wounds and depending on the level of the damage of spine is represented in Table 43.

Table 43 show some laws governing the relationships/ratios between the level of the wound on spine and the combined wound of other organs/controls. Thus, the wounds of neck division more frequently were combined with the damage of jaws, organs/controls of neck: the wounds of the thoracic division of spinal column were most frequently escorted/tracked by the wound of the organs/controls of thoracic area.

With the wound of lumbar-sacral division relatively more frequently were encountered the damages of the organs/controls of abdominal area, pelvis, and also lower extremities.

In the practice were encountered the most varied relationships/ratios on the severity of the damage of spinal cord and other organs/controls and systems. In some cases clinically more brightly became apparent the damage of spine and spinal cord, in other cases - damage of the vital organs/controls of chest, abdominal area, etc.

Table 43. Frequency of the combined and associated wounds of spine and spinal cord with other organs/controls (on the levels of wound) (in the percentages).

(1) Уровень ранения позвоночника	(2) Изолированные	(3) Мягкие ткани тулови- ща и конечностей		(4) Череп		(7) ЛОР-органы (ухо, нос)	(8) Лицо с повреждением челюсти	(9) Шея, проникающие ранения	(10) Грудь		(13) Грудобронхиальные ранения	(14) Живот, проникающие ранения	(15) Таз	(16) Конечности с повре- ждением костей	(17) Прочие сочетания
		(5) непроникающие	(6) проникающие	(11) непроникающие	(12) проникающие										
(18) Шейный отдел . . .	32,7	32,4	4,5	0,8	3,9	7,7	3,4	1,8	7,9	0,1	0,3	—	2,0	2,5	
(19) Грудной отдел. . .	27,3	20,0	0,7	0,3	—	0,4	0,2	4,9	32,2	0,4	3,0	0,3	2,8	8,0	
(20) Пояснично-крестцо- вый отдел . . . . .	33,2	24,5	0,7	0,3	—	0,2	0,1	4,2	3,0	0,6	6,9	7,9	3,0	15,4	

Key: (1). Level of the wound of spine. (2). Isolated/insulated. (3). Soft tissues of body and extremities. (4). Skull. (5). nonpenetrating. (6). Penetrating. (7). ENT organs (ear, nose). (8). Face with damage to jaw. (9). Neck, penetrating wound. (10). Breast. (11). nonpenetrating. (12). penetrating. (13). Diaphragm wounds. (14). Stomach, penetrating wounds. (15). Pelvis. (16). Extremities with damage of bones. (17). Other combinations.

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however, under all conditions the associated or combined wound



of other organs/controls exerted effect on the course of the wound of spine and of spinal cord, and, on the contrary, wound of spinal cord, and, on the contrary, the wound of spinal cord had indisputable effect on the clinical course of the damaged adjacent organ/control. This conditioned the greatest mortality with the combined and associated wounds, which achieved by 50.60/o.

Will be examined below the most frequently encountered varieties/subspecies of the combined and associated wounds whose treatment presented considerable difficulties and had its specific special features/peculiarities.

Separate means of the combined wounds.

Combined wounds of spine and skull. The combined wounds of spine and skull composed 2.00/o with respect to all wounds of spine (with the wound of neck division 5.30/o and on 1.00/o with the wound of the thoracic and lumbar-sacral division of spine). In this case in the hospital practice the wounds of skull were represented by usually moderat-/mild ones and played secondary role during the evaluation of the condition of casualty and prognosis of wound; the more rarely penetrating wound of skull was combined with the light damage of spine. Relationship of the nonpenetrating and penetrating wounds of skull in this case was expressed as 4/1. The obtained heavier wounds

perished in the foremost stages of evacuation. During the treatment of such casualties primary processing craniocerebral of wound was performed first of all and, with rare exception, it did not detain surgical intervention on the spine which was conducted 5-7 days after operation/progress on the skull, but sometimes and simultaneously.

Combined wounds of spine and face with the break of lower jaw. More frequently were encountered the combined wounds of lower jaw and neck division of spine. Based on materials of the development of the histories of diseases/sickness/illness/malady, the frequency of such wounds achieved 7.75/o with the wounds of neck division and 0.2-0.45/o - with the wounds on those lying of below the divisions of spine. The leading place in the clinic of the sharp/acute and early period of wound occupied, with rare exception, the damage to lower jaw. In similar cases the casualties usually entered the hospital separations/s-ctions of maxillofacial surgery, and in the absence of any noticeable manifestations of the damage of the neck division of spine and spinal cord or in the absence of complications from the side of spine (osteomyelitis) such wounds could remain for a long time unidentified (in more detail about such combined wounds see the "Experience of Soviet medicine in the Great Patriotic War", vol. 6).

Combined wounds of spine and organs/controllers of neck. This combination, according to the data of the materials of the

development of the histories or disease/sickness/illness/malady, was encountered into 3.46/c. Under conditions GBF for entire war were encountered only the single cases of the wound of spine in combination with the wounds swallows, the esophagus, trachea, large vessels, brachial plexus. Single observations give Z. I. Geymanovich (deep rear), G. P. Kornyskiy (GBF) M. B. Zvinyskiy (GBA) et al. The damage of the vessels on neck was more frequently noted in the direction of wound canal on the side in the frontal plane. Lethality with such combined wounds is high and in essence it falls on the foremost stages of the medical and sanitary service. The diagnosis of damages does not present special difficulty. Surgical tactics was reduced to the possible elimination of vitally risky complications and to prophylaxis of late or secondary hemorrhage.

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After the removal of casualties from the heavy condition were determined the readings to surgical intervention on the spine in the dependence on the character/nature of wound and clinical picture.

Combined and associated wounds of spine and chest. According to the materials of the development or the histories of disease/sickness/illness/malady, the combination of the wound of the thoracic division of spinal column with the nonpenetrating wound of

chest and multiple failure of lungs/fins is noted into 4.90/o, and combination with the penetrating wound of chest - into 32.20/o. With the wound of the neck division of spine, according to the same data, such combined wounds were encountered in 9.70/o; of them on the nonpenetrating wounds of chest rail 1.80/o, also, to those penetrating - 7.90/o, while with the wound of lumbar-sacral division - 7.20/o (4.20/o of nonpenetrating ones and 3.00/o of ones penetrating).

According to the observations of different authors, the frequency of such combined wounds very oscillates, which stands in the dependence on the stage of evacuation in which they worked. It should be noted that together with an improvement in the organization of the carrying out/removal of casualties from the field of breakage in the Great Patriotic war the frequency of such combined wounds under conditions GBF considerably increased not only in comparison with the materials of the first world war when such casualties in the single cases only achieved the hospital basis of front (V. I. Dobrotvorskiy et al.), but also in the comparison with the data of war with the White Finns (Ye. A. Permyakov and Ye. A. Uspenskiy).

According to the observations of I. S. Babochin (GBF), the frequency of the combined wounds of spine and chest achieved 15.00/o, B. P. Koryanskiv (GBF, 1943), -22.50/o, K. G. Terian (GBA),

-47.50/o.

According to the observations of T. A. Khilkovoy (GBF), analyzed the combined wounds of spine and chest with respect to the type of the wounding weapon, to the bullet wounds fall 67.00/o, also, on fragmentation -33.00/o. This is logical, since the combined wounds of spine and chest more frequently are connected with the long, oblique wound canals, which were being noted with the bullet wounds.

According to T. A. Khilkovoy's data, it entered on GBF during the period up to 1 week 49.00/o, including about the half during the first two days; from 1 to 2 weeks - 34.00/o; from 2 weeks to 1 months - 17.00/o.

The given numerals characterize the basic principles of the evacuation tactics in the relation to the combined wounds, which was established already into the first half war. The condition of these casualties was so/such heavy that more than half of them was detained in treat establishments of GDA by 2 weeks and more. The diagnosis of the combined wounds of spine and chest was based on the clinical analysis of wound and wound canal during an indispensable neurologic, therapeutic and x-ray examination. In 8.0-12.00/o of such combined wounds during the first days was detected the subcutaneous emphysema, which captured the large or smaller part of the thoracic division of

boly.

Based on materials of the development of the histories of disease/sickness/illness/malady, 32.20/o of penetrating wounds of chest with the combined wounds of the thoracic division of spine are distributed as follows: those penetrating without pneumothorax - 6.60/o; penetrating with pneumothorax - 25.60/o among other things of those penetrating with closed pneumothorax were 6.20/o and penetrating with that opened pneumothorax - 13.40/o.

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All available (according to the conditions of hospital and due to the condition of casualty) investigations with the combined wounds were conducted in the majority of the cases within the maximally short period, since surgical aid in these cases was usually urgent.

The first therapeutic measures were directed to the removal of casualty from the condition of shock, which frequently complicated similar wounds, and the most rapid possible elimination of the difficulty of respiration and violation of heart activity. The urgent measures included the sewing up of open pneumothorax.

The treatment of hemothorax was conducted through the

general-surgical principles (see "Experience of Soviet medicine in the Great Patriotic War", vol. 9).

Radical intervention on the spine in the rare cases only proved to be possible during the first days after wound, namely during the moderate/mild damages of the organs/controls of chest or with the nonpenetrating wounds of chest with small hemothorax and insignificant difficulty of respiration.

Readings to surgical to processing wound and to taking preventive measures for the purpose of warning/prevention of the infection of wound, lungs, urinary tracts, and also rule of departure/attendance remained the same as with the isolated/insulated wounds of spine and spinal cord.

Radical laminectomy proved to be feasible (during the appropriate readings) only after the elimination of complications from the side of the organs/controls of chest.

In the heavy cases or the combined wounds of spine and chest the prognosis always remained doubtful, but with wound of both the lungs against the background of the heavy damage of spinal cord even it did not remain hope for survival. Sometimes were encountered the very considerable hemorrhages in the pleural area, which achieved by 2 and

even 3 l of the blood, which impeded respiration and heart activity and strongly bled white casualty. Lethality with such combined wounds was very high and achieved 88.30/o.

The reason for death in the foremost stages of evacuation with the combined wounds of spine and chest was most frequently traumatic shock, less frequent asphyxia or pneumonia.

Under conditions GOR the damage of the organs/control of chest into 1/4 cases was only the direct cause for death with the average life expectancy of such wounded in 8-10 days. The remaining of 3/4 casualties perished from the complications, connected with the damages of spinal cord (sepsis, urosiosis, meningitis) and of wound infection; the lifetime of this group of casualties achieved 38-45 days.

Combined and associated wounds of spine and abdominal area. The combined wounds of spine and abdominal area were encountered considerably less frequent than the combination of the wound of spine and chest, and they achieved, based on materials of the development of the histories of disease/sickness/illness/malady, only 4.30/o of all wounds.

The cause of the contusions of the organs/control of abdominal



area, which complicated the wounds of spine, were frequently noted on the autopsy by the individual authors (A. A. Kulikovskaya).

The diagnosis of the wounds of the organs/organs of abdominal area or kidneys, which associate the wound of spine and spinal cord, presented frequently considerable difficulties.

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Paralysis of the muscles of abdominal press, as a result of the damage of spinal cord, eliminated the shielding stress/voltage of abdominal wall even in the cases of emergent peritonitis. The delay of urination and defecation was also the natural satellite of the damage of spinal cord. Did not help diagnosis the presence of the blood in the urine, which was being frequently observed already after the first catheterization and without the bullet wound of the bladder or kidneys. Deciding for the diagnosis under conditions DMP remained the possible surgical analysis of wound canal, very difficult in the cases of blind-end wounds, especially with the long, oblique wound canals. Repeated vomiting, frequent small pulse, dry tongue, accumulation of fluid/liquor (blood) in the abdominal area in the not established/installed accurately direction of wound canal and with rapid deterioration in the condition of casualty (in the limits of several hours of observation) impelled the surgeons of DMP to produce

laparotomy/celiotomy, in the absolute majority of cases (88.00/o) confirmed the damage of the organs/controls of abdominal area.

According to data of A. A. Kulikovskoy's autopsies (GBF), the associated wounds (and contusions) of parenchymatous organs/controls into 12.00/o were not intravitaly diagnosed, moreover these errors for diagnosis were encountered not only with the final results into the first 2-3 days after wound, but frequently and with the lifetime of casualty in 3-6 weeks and more. Under conditions of army or front line area the establishment of correct diagnosis helped the fluoroscopy (trechoscopy) or X-ray analysis with the blind-end wounds of abdominal area.

In the doubtful cases was conducted exploratory laparotomy.

With the combined wounds of spine and abdominal area more frequently proved to be wounded the intestine and the liver, while with the retroperitoneal wounds - kidneys and retroperitoneal divisions of thick intestine.

Surgical intervention on the spine in the shown cases proved to be possible during the favorable course after only 2-3 weeks after laparotomy/celiotomy on the output/yield of casualty from the heavy condition and the liquidation of the complications, connected with

the damage of internal organs/organs.

4. obtained 20/VII 1943 the combined blind-end bullet penetrating wound of abdominal area with the tangential penetrating wound of spine at the level of III lumbar vertebra and with the heavy contusion of rootlets or horse tail and cone of spinal cord.

20/VII on 04P is produced the dissection of wound in the left buttock region and laparotomy/colotomy with the sewing up of two wounds of the sigmoid colon. In the post-operation period is noted the complication in the form of evisceration.

23/VII is entered into specialized hospital G3F, where during the same day is produced the sewing up of abdominal wall.

Casualty transferred bilateral pneumonia, cystopyelitis.

30/VII laminectomy with the removal/distance of the bone fragments, which squeezed dural sack at the level of the III-IV lumbar vertebra, and the bullet, which was being arranged/located in the soft tissues of right lumbar region.

Post-operation course is smooth. Gradually were smoothed pains and paresis of lower extremities. Was reduced the normal function of

pelvic organs/controls.

Through 3 years he works by chief machine operator of plant.

Surgical treatment was combined in all cases with the energetic use/application of antiseptics and antibiotics, and also with the indicated above preventive measures, directed toward warning/prevention of the complications of infectious and tropho-paralytic character/nature (decubitus, complications from the side of the urinary tracts, etc.) in connection with the damage of spinal cord.

Prognosis with the combined wounds of spine and organs/controls of abdominal area always remains doubtful.

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The issue of wound is prognosis both on the severity of the damage of spinal cord and on the wound of one or the other organs/controls of abdominal area, and also on the periods and the character/nature of intervention and on post-operation treatment.

According to the data of G3F of Leningrad Front, with the combined wounds of spine and intestines lethal outcomes are noted into

53.00/o of all cases, with the wound of the spine and liver - into 30.00/o of cases, spleen - into 87.50/o, the diaphragms/midriiffs (with the damage of the organs/controls of chest and abdominal area) - in 95.00/o of cases, and with the wound of spine and kidneys - into 90.50/o.

The cases of recovery were possible only during the damage of one kidney whose removal/distance far on is always justified. The perforated and edge/boundary wounds of kidney with sewing up or tamponade of the affected sector with gasket, muscular graft/flap and the like were finished happily with the retention/preservation/maintaining of the function of kidney (A. N. Bakulev).

Frequently with such combined wounds simultaneously inflicted damage on themselves to the number of the organs/controls of abdominal area. Such wounds, with rare exception, were incompatible with the life.

By the reason for death of those obtained the combined wound of spine and organs/controls of abdominal area usually were shock, sharp/acute blood loss, peritonitis, thin- complications, connected with the damage of the spinal cord (see Chapter III).

Combined and associated wounds of spine and pelvis. The frequency of such wounds, according to the materials of the developed histories of disease/sickness/illness/malady, achieved with the wounds of a lumbar-sacral division 7.90/o, including damage of the bones of pelvis is noted into 0.80/o, rectum - into 1.00/o and the bladder - into 0.10/o. The combination of the wound of the thoracic division of spine with the wound of pelvis is noted in all into 0.30/o. Surgical tactics with such wounds in principle in no way differed from tactics with the combined wounds of spine and organs/controllers of abdominal area. The special feature/peculiarity of these wounds was the danger both of the penetration of infection into the spinal canal and the onsets of osteomyelitis of rump and outbreak of anaerobic infection made of the damaged muscular masses of buttock region.

The damage of the organs/controllers of a small pelvis exerted a substantial influence on the issues of wound, raising lethality with them to 64.00/o.

The reason for death was more frequently ascending car-bronspinal meningitis, pelvioperitonitis, or osteomyelitis of rump and bones of pelvis with secondary wound cicatrix. Surgeon's permanent attention required timely development/detection and autopsy of possible here suppurative flows, phlegmons, and also prophylaxis of anaerobic

infection.

Combined and associated wounds of spine and extremities. Based on materials of the development of the histories of disease/sickness/illness/malaria, the combined and associated wounds of spine and extremities with the damage of bones are noted into 2.00/0, moreover the damages of the upper extremities were encountered 2 times more frequently than lower ones.

The damage of extremities undoubtedly complicated care of casualties, but, as a rule, did not exert a substantial influence on the periods and the readiness to surgical intervention on the spine, and in the small measure it also only influenced the issue of wound (quo ad vitam).

The damages of the paralyzed extremities were not usually ascertained/tracked by complaints on the part of casualty and therefore they required surgeon's close attention to avoid the survey of the possible outbreak of anaerobic infection.

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With the bullet breaks of the paralyzed extremities in combination with the heavy damage spine and spinal cord large gypsum

Bandages with the corset, as a rule, did not lay. Taking into account paralysis of the damaged extremity, surgeons were usually limited to the imposition of gypsum longer bandage or even wire splint, which facilitated observation of the extremity.

It should be noted that the wound of spine and the damage of spinal cord or horse tail did not exert a substantial influence on the healing of the wounds of extremities and the consolidation of breaks, or to the healing of wound after the amputation of extremities and formation of scarp.

In one case of the wound of the lumbar division of spine with the damage of spinal cord (wounded K.) was produced osteoplastic Bristi amputation on both paralyzed extremities at the level of upper third of shin. The healing of wounds is smooth. 3 months after the amputation of patient it could be moved on the shortened lightened prostheses with the aid of the crutches or even bacilli/rods (observation of D. G. Goldberg and F. A. Kopylov).

One should emphasize that with the combined wounds of spine and other organs/controls and systems clinic and diagnosis, and also tactics of surgery and prognosis depended on the severity of the wound both spinal cord and vital organs/controls. The treatment of such casualties required the complex observation of surgeon,



neurosurgeon (or neuropathologist) and therapist, and sometimes also biologist, stomatologist and other specialists. Gaining of experience during the Great Patriotic War led to an improvement in the issues of the combined wounds in the second half war.

Multiple wounds of spine. With the wounds by several wounding shells the spine can be wounded on two and more levels. Based on materials of the development of the histories of disease/sickness/illness/malady, such wounds are noted into 0.40/o.

During the damage of spine at two different levels neurologic manifestations depended on the character/nature of wound and degree of the damage of spinal cord at the proximal level of wound, another focus could be looked over during the primary investigation, since the symptomatology of extremital wound was closed over with the proximally arranged/located focus.

In one such case A. G. Stolz (GBF) produced laminectomy in casualty at the level of the IV-V thoracic vertebra, with which they removed metallic fragment from the spinal canal. In 2 1/2 months was only discovered the wound of the small arc of the lumbar vertebra (point wound in the lumbar region did not draw to itself attention at the moment of the admission of casualty).

With second laminectomy were removed the bone fragments of small and small metallic fragment, that squeezed dural sack. After the second operation/process in patient began to be reduced the active movements of lower extremities and disappeared pains in them.

Surgeon's tactics during the multiple damages of spine was reduced usually to intervention first at the level of main focus. During the favorable course and the corresponding readings proved to be necessary second intervention at the level of secondary or the clinical manifestations focus or with the development/detection of two foci of the damage on spine operation/process was conducted simultaneously at both levels.

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Chapter IV.

#### COMPLICATIONS OF THE BULLET WOUNDS OF SPINE AND SPINAL CORD.

(clinic, diagnosis, prophylaxis, treatment).

The complications of the bullet wounds of spine and spinal cord in terms of their origin can be divided into four groups:

1. Complications traumatic, caused by severity and character/nature of the wound of spine and of spinal cord, and also by character/nature of the associated damage of other organs/controls and systems. Her is involved shock, sharp/acute blood loss, liquorrhea, etc.

2. Complications (infectious. This group includes the infection of wound, focus or diffuse suppurative meningitis, myelitis, abscess of spinal cord, osteomyelitis, etc. To the same group with the known basis can be referred the secondary infectious complications: the ascending infection of the urinary tracts (cystitis, pyelonephritis), pneumonia, infection of wounds.

3. Complications tropho-paralytic, caused by paralysis and violation of trophic system as a result of wound of spinal cord. To this group can be referred the ulcers, contractures, edemas of extremities, complication from the side of different visceral foci, gastrointestinal tract, kidneys, etc.

4. Complications, caused by reducing and reparative processes in spine and its contents. Here are involved such complications, as arachnoiditis, spondylosis, spondylarthrosis.

This division of complications is virtually convenient, although it is not deprived of known sketchiness, since in pathogenesis of complications the significant role plays a number of factors. As an example can serve such complications, as pneumonia in onset of which, besides the infection, the vital importance has paralysis of respiratory/breathing musculature. Then relates to the infectious complications of the urinary tracts in course of which it is difficult to overestimate the value of the violations of trophic system. Reducing, productive processes in the shells and the spinal cord can flow/occur/last both aseptic and with the doubtless participation of infection.

The complications of the bullet wounds of spine and spinal cord on the periods of onset can be divided into two groups:

1) the early complications, which appear in the sharp/acute and the early, less frequent in the intermediate period of wound.

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Here it is involved shock, hemorrhages, liquorrhea, abscesses, pneumonia, suppurative processes in the wound, the soft tissues, the spine, the shells, in the spinal cord, and also complications from the side of the urinary tracts, intestine and the like;

2) the late complications, which appear in the late and, less frequent, in the intermediate period. Here are involved the various forms of arachnoiditis, strain of spine and spondylosis with the secondary compression of spinal cord, late changes in the spinal cord and so forth, etc.

For the practical targets of expediently examining the enumerated complications on the time of their onset, adhering to the schematic division, given above, particularly stopping on the specific ones for the wounds of spine and spinal cord the complications, which are encountered most frequently and having vital

importance for course and issue of wound.

Early complications.

Traumatic shock. The bullet wounds of spine and spinal cord are fairly often complicated by traumatic shock. According to the data of the development of the histories or disease/sickness/illness/malady, the relative frequency of shock with these wounds is calculated into 4.90/o, achieving in the heavy cases of the combined wounds of spine and spinal cord 37.20/o.

Traumatic shock was observed more frequently in the foremost stages, in the army and army area, less frequent in the institutions GBF.

According to the materials of protocols of autopsies, the shock as the reason for death with the heavy penetrating combined wounds of spine is noted into 27.00/o of cases and in combination with the blood loss into 13.00/o more. with the nonpenetrating isolated/insulated wounds of spine shock as the reason for death it was possible to establish into 32.10/o and shock in combination with the blood loss into 7.20/o 1.

FOOTNOTE 1. To the detailed study of this problem are dedicated individual Chapter One section. ENDFOOTNOTE.

During the treatment of shock in such casualties attention was paid to the zones of the fall-out of sensitivity and the lowered/reduced resistivity of tissue in connection with the disrupted trophic system in the paralyzed divisions of body, which required especial care with the use of heaters for the heating of casualties. For the same reasons intravenous injections and especially subcutaneous and intramuscular were conducted into the unparalyzed divisions of body. In other respects the treatment of shock in those wounded the spine in no way differs from the treatment of shock in those wounded other regions of the body (see section of the I work "Experience of Soviet medicine in the Great Patriotic war").

Hemorrhage. Hemorrhage with the bullet wounds of spine in the therapeutic institutions of army area was encountered sufficiently rarely and only in the single cases it is noted in the material of the hospitals of the army and front line area (less than 1.00/o). These hemorrhages were most frequently connected with the wounds of adjacent organs/organs and tissues and it is rare with the wound of spine itself and spinal cord. Thus, among those wounded the spine and

the spinal cord, dead persons on the field of battle, death from the hemorrhage from different internal organs/controls is noted into 30.20/c (Ye. A. Uspenskiy, V. L. Byalik).

Sometimes were encountered late and repeated hemorrhages from the wound during the damage of considerable muscular masses and large vessels in the distance from the spine.

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The cessation of hemorrhage in this case was reduced, according to general-surgical principles, to the expansion of wound, the development/detection of the bleeding vessel and ligation either its facing or, finally, in the appropriate cases to the dressing of vessel for the elongation/extent. Latter/last more frequently had place with the hemorrhages from the wounds of buttock region.

Sometimes were observed the hemorrhages of erosional character/nature from the lacerations in sacral-buttock region. Such hemorrhages stopped usually, forcing by several minutes against the bleeding sector the gauze towel, moistened by peroxide of hydrogen or by thrombin. Immediately after wound those threatening life were the hemorrhages from the intervertebral vessels, which sometimes appeared after blind-and wounds in the region of intervertebral aperture as a



result of the displacement of foreign body. To stop hemorrhage in this case was only by means of tamponade on 5-7 days or by the dressing of vessel for the elongation/extent, especially in the cases of hemorrhage in the neck region from the spinal artery. According to the experiment/experience of the Great Patriotic War the greatest danger for the life of those wounded the spine and the spinal cord presented the hemorrhages into the internal areas, in particular, into the pleural area, the bladder, etc., which rapidly bleed white casualty. Struggle with the loss of the blood and the anaemisation in this case was led by the fractional transfusions of blood, introduction of calcium chloride, plasma, vitamin K, etc. Necessary was the timely and active removal/drainage of the issuing from blood from the areas to avoid its suppuration.

Liquorrhea and liquor fistula. In the first hours after wound the admixture/impurity of a considerable quantity of blood and wound discharge to the ensuing/escaping/flowing out cerebro-spinal fluid frequently masked liquorrhea, and the latter slipped off from surgeon's attention. Subsequently the ensuing/escaping/flowing out cerebro-spinal fluid acquired increasingly less and less intense stain/staining (reddish-brown, yellow, yellowish) was covered/coated sometimes with the lump, seemingly greasy coating. In those cases liquorrhea easily it was distinguished. Liquorrhea in the Great Patriotic War was noted by surgeons and neuropathologists fairly

often. Thus, among the penetrating wounds of spine it was encountered into 16.80% of cases. Very large interest was of the frequency of liquorrhea with the wounds of spine and spinal cord at different levels, which clearly illustrates Tables 44.

From the given numerals it is evident that most frequently liquorrhea was encountered with the wounds of a lumbar-sacral division of spine and completely it was not encountered with the wounds of neck division.

Depending on the sizes/dimensions of the defect of solid cerebral shell and level of the wound of spine liquorrhea lasted from several hours to 1 1/2-2 weeks, less frequent longer. The cases of especially prolonged liquorrhea were observed with the wounds of lumbar-sacral division of spine.

Table 44. Frequency of liquorthea with the penetrating wounds of spine depending on the level of wound.

(1) Частота ликворрей	(2) Уровень ранения	(3) Ш-ный отдел	(4) Грудной отдел	(5) Пояснич- но-крест- цовый отдел	(6) Множе- ствен- ные ранения	(7) Всего
(8) К общему числу ликворрей . . . . .	—	—	8,5	89,2	2,3	100,0
(9) К общему числу проникающих ра- нений того же уровня . . . . .	—	—	1,4	15,0	0,4	16,8

Key: (1). Frequency of liquorthea. (2). Level of wound. (3). Neck division. (4). Thoracic division. (5). lumbar- sacral division. (6). Multiple wounds. (7). In all. (8). To total number of liquortheas. (9). To total number of penetrating wounds of the same level.

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Stopping liquorthea with the wounds at the level of spinal cord was achieved by insulation/isolation of sub-arachnoidal space by the intergrowth between the shells and the surface of spinal cord. Spinal cord, after increasing as a result of edema in its cross sides/dimensions, forces soft shells against the sides of defect in the solid cerebral shell, thereby contributing to their rapid joining between themselves, and subsequently and to the education of dense intergrowth. However, with wounds of solid cerebral shell in the limits of horse tail this important condition, which is favorable to

the approach of skulls, is absent, and defect in the skull for a long time remains gaping.

The cases of prolonged liquorrhea, not removed on one or the other reasons by operative means, greatly frequently were complicated by the suppurative inflammation of cerebral shells or spinal cord.

Of 35 casualties with liquorrhea, who were being observed by I. Ya. Lazicel'skiy and who were not subjected to surgical treatment, in 25 wounds they were complicated by the heavy suppurations: in 9 - by cerebrospinal suppurative meningitis, in 11 - by restricted suppurative meningitis, in 3 - by suppurative myelitis and in 2 - by abscesses. These observations in essence related to the first two years of the Great Patriotic War.

Massive liquorrhea was always considered as leading to surgical intervention for the purpose of the plastic occlusion of defect in the solid cerebral shell.

Which insignificant liquorrhea the treatment in the majority of hospitals remained conservative and was reduced to the stacking of casualty to an stomach with one elevated pelvis or to the elevation of the foot end of the bed on 40-60 cm. Experiment/experience showed what position/situation is the casualties withstood without the

special work during 5-7 days, usually sufficient for the development adhesive processes in the shells. This measure frequently led to the liquidation of liquorrhea.

Fistula course or wound canal in this case was loosely fulfilled by gauze (without dense tamponade). I. S. Babchin in this case introduced intravenously glucose for the purpose of dehydration. M. M. Burisko high value added saknoyaleniya, together with other the measures indicated above.

Liquorrhea was observed also with the insufficiently airtight suture of solid car brain shell after the operations/processes, produced into different ones.

When more or less stable liquorrhea, which arose in the post-operation period, some neurosurgeons resorted to the carving of fistula and the triplostichous sewing up of wound. A. L. Polenov in similar cases resorted to the broaching of muscles through the integuments without the carving of fistula (liquor) course.

Complications on the part of the urinary tracts. In the sharp/acute and early period of the wounds of spinal column and spinal cord more than in the hard the cases were observed the disorders of pelvic organs/controls (54.90/o), in particular,

inations (52.35/o).

The violation of urination very complicated care of those wounded the spine and presented serious danger for their life. The stagnation of urine, together with the violation of digestion, metabolism and the development of infection, created favorable conditions for the alkalization of urine with the subsequent deposit of concretions (usually phosphatic) in the urinary tracts (A. I. Vasil'yev, M. A. Lyulin, V. S. Rozhd'estvenskiy, B. A. Simukler).

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Albuminuria, which was appearing during the first days, witnessed the early reaction of kidney epithelium (cross-country ability for protein). Comparatively rapidly appeared the infection of the urinary tracts.

During the bacteriological investigation of urine in the cases of suppurative and pyo-hemorrhagic cystitides in such casualties (in the early and intermediate period) M. V. Kryzhanovskaya (GBF, 1943) found that microflora more frequent was represented by the association of the coliform bacterium and *Proteus* with the hemolytic streptococcus; more rarely was seen golden streptococcus in the association with the coliform bacterium and *V. putrificus* or one

coliform bacterium. To this contributed the presence of the infected wound against the background of the weakened organism of casualty and mainly the need for catheterization. After arising in the peripheral divisions of the urinary system in the form of urethritis or cystitis, infection in extra-blady case rapidly is advanced in the ascending direction, destroying pelvis and parenchyma of the kidneys (pyelonephritis), leading frequently to the development of urosepsis, being the reason for death of that wounded.

Based on materials of the development of the histories of disease/sickness/illness/wound, urosepsis was the reason for death into 25.70% of cases, while based on materials of the protocols of autopsies - into 29.50%.

Already within the next few days after the wound of spinal cord attacked/advanced deep changes in the wall of the bladder, which captured not only mucous membrane and submucous layer, but also entire thickness of the wall of the bladder and which led to the development of ulcerous and necrotic cystitis. This numbness applied to the larger or smaller surface of the walls of the bladder and sometimes it led to the full/total/complete rejection/separation of the larger unit of the mucosa and submucous layer and even to the necrosis of the sectors of muscular layer.

From 167 autopsies of those wounded spinal column M. A. Lyubin (88%) revealed/introcted cystitis in 132 dead persons (79.06/o), of them catarrhal - in 13, suppurative - in 51, hemorrhagic - in 25, necrotic - in 10, ispheneratic - in 3, necrotic - in 25 (of them 3 perforated).

Sometimes the wounds of spine and spinal cord were associated/tracked by hematuria of different degree, which frequently led sometimes to the rapid development of secondary anemia. In the absence of the associated wound of kidneys or bladder such a hematuria was considered as the consequence of vasomotor-trophic violations, sometimes as the consequence of the rapid emptying of the bladder with catheterization (hemorrhage *ex vacuo*).

Experiment/experience showed that changes in the bladder, as in other divisions of urinary/urine apparatus, to a considerable extent they depended on the method of the removal/diversion of urine, applied in the case of the delay urination.

Within the time of the Great Patriotic War were applied the following methods of the removal/diversion of the urine:

1. Manual extrusion.



2. Catheterization: a) periodic, b) constant, c) constant with cast drainage.

3. Removal of urine via capillary puncture.

4. Suprapubic fistula.

Manual extrusion. Manual extrusion of urine applied individual neurosurgeons, if we introduce catheter was difficult or for the purpose of prophylaxis of the infection of the bladder.

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As showed experiment/experiences, extrusion of urine sometimes possibly, but it should be produced with the maximum care, being limited only to cautious and systematic pressure to the bottom and partly to the front/leading wall of the overfilled bladder. In the Soviet Union to the extrusion of urine resorted G. P. Larin, V. V. Gorinevskaya, A. V. Bondarchuk et al. However, this method was applied rarely as a result of the possible complications.

Periodic catheterization. Method most widely used, but also most disputable/most debatable, and in the opinion of some neurosurgeons, and most risky.

At the beginning of war Soviet neurosurgeons' majority adhered to that view, that daily catheterization (2-3 times), produced by doctor with the observance of all rules/handspikes of asepsis, is the best method of prophylaxis of urinary bladder complications.

However, experiment/experience showed, how it is difficult to sometimes conduct the elastic catheter through the spastically abbreviated/reduced external and internal sphincter of urethra; as pain in this case is disturbed, and already after several catheterizations appears infection in the urethra and the bladder with the tendency of dissemination in the ascending direction.

Only in the cases of wounds with the insignificant violation of trophic system under particularly favorable hospital conditions daily catheterization passed without any considerable infection of the urinary tracts.

During the considerable violation of trophic system systematic, daily, prolonged catheterization even by soft catheter was frequently complicated, besides the infection, by the education of false courses in tail end of the urethra (pars membranacea) and even perforation of the bladder with secondary peritonitis.

Neurosurgeons' majority toward the end of the war put to use periodic catheterization only in the cases of the insignificant damage of spinal cord or horse tail, that left hope for a comparatively rapid reduction of random urination.

In connection with the known difficulties of conducting the soft catheter through the spastically abbreviated/reduced sphincters, and also for the purpose of the provision of the greatest asepsis during the catheterization some neurosurgeons put to use metallic catheter. However, it is necessary to emphasize the danger of this method for the casualties with the disrupted trophic system of the bladder against the background of the lost sensitivity. If catheterization produces even experienced doctor, in this case is possible the creation of false course and the perforation of urethra and bladder. A similar case occurred in one of the hospitals of Leningrad Front. A similar case occurred in one of the hospitals of Leningrad Front. For understood reasons this method did not win acceptance.

Permanent catheterization. On the basis of the experiment/experience of peacetime the urologists and surgeons recommended to put to use permanent catheter for the removal/diversion of urine with the wounds of spine and spinal cord.

However, experiments/experience showed that the permanent catheter in casualties with the damage of spinal cord or horse tail could find very limited application for a number of reasons. Fixation of catheter to the floor/sax term with the disrupted trophic system sometimes rapidly led to the formation of balanitis with paraphimosis, and sometimes even to the gangrene of floor/sax term.

We noted the cases of the necrosis of mucous urethra, of bladder and head of floor/sax term, and also of phlegmon of scrotum and the development of the urethral fistula with the prolonged use of permanent catheter. Permanent catheter drained the bladder, but it did not drain urethra, moreover it facilitated the advance of infection into the bladder.

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Therefore with the prolonged use of permanent catheter frequently was observed the development of balanitis, balanocystitis, paraphimosis, candidymite, orchitis, prostatitis, bedsores and ulcerations/pittings of mucous urethra, up to the perforation of urethra with the formation of stable urethral fistula. All this proved to be possible even under the condition of systematic exchange and washing of the catheter of every 2-3 days.

In the cases of unsuccessful fixation permanent catheter dropped out outside, and sometimes it slipped into the area of the bladder, and then it was necessary to drive out operationally. All this considerably limited the possibility of applying the permanent catheter in those wounded into the spine.

Permanent catheter with the cast drainage. Under conditions of the deep rear Z. I. Geymanovich (1943) recommended the applying of permanent catheter with the cast drainage.

The essence of method consisted in the fact that into the free end of the catheter was inserted the U-shaped glass tube with two rubber points: through one of them the bladder was washed, and through another withdrew urine and wash liquid. But also this method did not obtain any wide acceptance.

Capillary puncture. The puncture of the bladder for the purpose of the removal/diversion of urine with the wounds of spine and spinal cord was recommended in the Soviet Union of Prof. A. A. Chayk. Puncture in this case is conducted by the Birov needle through abdominal wall, which, on the assertion of the author, was safe with the expanded bubble (peritoneum was displaced upwards); urine in this case is exhausted by syringe. In this case to unconditionally more easily observe the requirements of asepsis. To this method

sporadically resorted individual surgeons at different fronts (A. I. Vasil'yev, G. A. Gomzyakov et al.).

Suprapubic fistula. A comparatively wide acceptance in the Great Patriotic War, especially from its second half, obtained the method of removal/diversion urine by the imposition of suprapubic fistula (cystostomy), widely propagandized already from the first days of war by A. M. Bakulev as the most important preventive measure in the struggle with cystitis and urosepsis.

According to the investigations of M. A. Lyubin (hospital basis of Leningrad Front), the frequency of finding of urinary bladder fistula with each year of war all grew/rose. Thus, according to obtained by it data, if in the hospitals of Leningrad Front in 1942 were encountered only the single cases of finding of urinary bladder fistula with the wounds of spine, then in 1943 urinary bladder fistula was superimposed into 3.50/o of wounds of spine and spinal cord, and in 1944 - into 20.00/o of such wounds.

Based on materials of the development of the histories of disease/sickness/illness/malady, urinary bladder fistula was superimposed into 20.20/o of wounds, which were being escorted/tracked by the disorder of urination.

On the basis of pathoanatomical investigations L. I. Smirnov arrived at the conclusion that earlier and the correct imposition of superpubic fistula was the factor, which inhibits malignant coursing of cystitis and preventing the development of suppurative nephritis.

According to data of N. I. Cherkalovoy's autopsies, of 130 casualties without the superpubic fistula it died of urosepsis of 56 people, and of 20 casualties with the superpubic fistula of 2 people.

Similar observations bring R. S. Orlov, D. Ya. Varshavskaya, M. A. Lyubin et al.

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As showed experiment/experience, urinary bladder fistula did not always prevent the development of complications from the side of the urinary tracts, but the latter it appeared somewhat more lately and more easily they flowed/occurred/lasted. According to M. A. Lyubin's data, on 36 dead casualties with that superimposed with the life 5-30 days after wound by urinary bladder fistula only in 4 it was possible to note the signs of urosepsis and only in 2 necrotic ulcerous cystitides with the perforation of the bladder. In the latter/last cases the fistulas were superimposed not long before death.

The average life expectancy of casualties with the heavy damage of the thoracic division or spinal cord without finding of superpubic fistula was 36.2 days, and in the cases of the imposition of superpubic fistula - 100.5 days.

Thus, the advantages of removal/diversion of urine by the imposition of superpubic fistula are completely obvious. However, one should emphasize that the urinary bladder fistula should be laid within the early periods after wound.

Based on materials of the development of the histories of disease/sickness/illness/malady, urinary bladder fistula was superimposed within the following periods after wound (in the percentages):

3-5 дней (1)	32.2
6-10 " . . . . .	24.3
11-20 " . . . . .	17.7
21-30 " . . . . .	18.4
1-2 месяца (2)	6.0
2-3 " . . . . .	0.7
(3) Свыше 3 месяцев . . .	0.7
	<hr/>
	100.0

Key: (1). days. (2). month. (3). It is more than 3 months.

Thus, almost to the half the casualties of cystostomy was produced later than 10 days from the moment/torque of wound, i.e., in



time when already usually appears the infection of the urinary tracts.

This is evident from following data: urinary bladder fistula was superimposed preventive into 39.40/o; with the initial forms of cystitis - into 21.70/o; with fibrinogenous-necrotic cystitis - into 17.00/o; with urosepsis - into 17.70/o; it is not explained into 4.20/o, i.e., in 60.00/o of cases superpubic fistula was superimposed already in the phase of the emergent complications. Sometimes late finding of urinary bladder fistula helped to take casualty away from the septic condition.

For A. M. Bakulev in 41 case of 80 thus it was possible to take casualties even away from the condition of developing urosepsis.

A. 24/VII 1944 obtained the blind-end fragmentation penetrating wound at the level of the XII thoracic and I lumbar vertebra with the syndrome of the partial violation of the conductivity of spinal cord at this level.

After wound it was noted the stable delay of urine. Removal/diversion of urine by daily catheterization. Urine always it remained alkaline, turbid, with the content of protein to 3.66%<sub>um</sub> by a small quantity of unchanged and disintegrated erythrocytes and by a

considerable quantity of leukocytes in it, by the places of those covered/coated - fair- field of view. 15/IX developed the heavy picture of proctitis. 22/IX it was sup rimposed superpubic fistula. To 15/X the general condition of patient was improved, the septic picture disappeared.

26/X it is pronounced laminotomy. Post-operation course is smooth. During February 1945 is eliminated the urinary bladder fistula, which existed 6 months. Through 3 years, on the obtained information, urination random, with small stretching. It walks on the crutches.

However, too late an imposition of urinary bladder fistula more frequently proved to be barely effective.

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To the imposition technique of the urinovescical fistula. Before the operation/process the bladder was washed in antiseptic solution/opening to the full/total/complete clarification of wash liquid. Then into the bladder it was introduced by 200-300 cm<sup>3</sup> of fluid/liquid or air.

Neurosurgeons' majority put to use local anesthesia, introducing into the perivesical cellulose a small quantity 2o/o solution of novocaine.

By section/cut along the center line above the pubes was uncovered the bladder. Peritoneum they displaced upwards, and cystostomia it was conducted possibly nearer to the head of the bladder (sectio alta) with the introduction of drainage to the bladder. Drainage was fixed/recorded well with sutures to the wall of the bladder and the abdominal wall on 7-8 days. As a rule, to the 8th day fistula was completely formed, and drainage was extracted for the washing, the disinfection, etc. Insufficient fixation of drainage and its fallout during the first days after operation/process extremely

complicated its repeated introduction.

Urinovesical fistula is expedient for dealing with urinary infections and the alleviation of care of casualties. The prolonged stay of drainage in the bladder, especially during the low imposition of urinovesical fistula, led to the wrinkling and the sharp decrease of the capacity of the bladder. As reading to the liquidation of urinovesical fistula served the appearance of perception of filling of the bladder and urge to the urination. Checking was realized usually by temporary/time pressing of drainage by terminal. Especially convincing was in this respect sometimes the possibility of random urination detected.

As showed experiment/experience, upon the liquidation of urinovesical fistula in the course of the first 6 months after its imposition was required neither carvings of fistula nor stitching on the defect in the wall of the bladder. The introductions of the permanent catheter through the urethra to 7-10 days and tamponades of fistula course it was completely sufficiently for the rapid occlusion of fistula.

On the average urinovesical fistula was occluded 4-6 months after wound.

G. obtained 12/X 1944 the blind-end fragmentation penetrating wound at the level of the XI thoracic vertebra with the partial violation of the conductivity of spinal cord at the level of the twelfth thoracic segment. Two weeks was noted the full/total/complete violation of the conductivity of spinal cord from this level.

17/X is superimposed superpubic fistula.

15/XI it is produced laminectomy; is discovered the damage of solid cerebral shell with the projecting above its defect metallic fragment by the size/dimension 1x0.4 cm. Partial damage (defect of posterior column) of spinal cord to the left. Anechoic suture. Post-operation course is smooth. Urinovesical fistula functioned well. In the urine were noted a small quantity of protein - to 0.099 0/00, erythrocytes not changed, 3-5 in the field of view, during the separate days to 150-200 leukocytes in the field of view. In the sediment amorphous phosphates.

29/I 1945 appeared vesical tenesmus with the temporary/time disconnection of drainage.

1/II 1945 (3 1/2 months after cystostomia) drainage is removed. Is introduced the permanent catheter through the urinating canal. 10/II urinates independently.

Through 3 1/2 years the urination is normal.

In the appropriate cases even shorter-time urino-vesical fistula had vital importance for prophylaxis of the infection of the urinary tracts.

During the premature removal/diversion of drainage and the new outbreak of infection in the urino-genital system it was necessary sometimes to repeatedly lay urino-vesical fistula, which also gave favorable results.

With all methods of the removal/diversion of urine was conducted the systematic washing of the bladder.

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Surgeons' majority put to use for this purpose 20/o solution of boric acid, Rivanol (1:1000) or dilute solution of potassium permanganate (1:5000) (pale lilac solution), or even simple boiled water. In the cases of hematuria toward the end the washings into the bladder introduced 20 cm<sup>3</sup> 20/o solution of collargol or protargol, leaving this solution in the bladder, or latter/last washing is produced with

the solution of silver nitrate (1:3000-1:4000). N. I. Grashchenkov introduced into the bladder phages, in the dependence on the microflora, discovered in the urine.

To patient they simultaneously assigned inside sulfidine, urotropin: the concoction of bear ear (15.0-20.0 to 200.0; on 1 tablespoon of 3-4 times in the day) and so forth, etc. Under these conditions to patient they usually assigned abundant drinking.

In the alkaline urine and the presence of phosphates in the microscopic sediment some urologists assigned to patient the phosphoric or citric acid (V. S. Rozhdestvenskiy, B. A. Shaukler).

Vital importance neurosurgeons' majority was added to the vitaminization of such patients, especially by vitamins B<sub>1</sub> and C.

The experiment/experience of the Great Patriotic War showed that in the majority of the cases of the bullet wounds of spine the function of urination was restored in the intermediate and late period or casualty was adapted to the new established conditions of urination. It was necessary to protect this casualty from the dangers, connected with the delay of urine within the early periods after wound, frequently fateful for the life of casualty, utilizing all obtained in the experiment/experience of the Great Patriotic War

data on the rational departure/attendance and the treatment of the complications of the urinary tracts.

Bedsore. With the wounds of spine with the massive damage of spinal cord or rootlets of horse tail the bedsore appeared sometimes already on the 3-5th day, achieving sometimes the significant magnitude.

According to the data of the development of the histories of disease/sickness/illness/malady, the bedsore with the penetrating wounds were noted in the specialized hospitals of army (GBA) into 28.50/o, in the specialized hospitals of front (GBF) - into 16.80/o and in other institutions of front - into 19.30/o.

Based on materials of the reports of the specialized hospitals (GBF) of Leningrad Front, most frequently the bedsore were encountered with the wound of the thoracic division of spine, especially lower-thoracic division (36.70/o), somewhat thinner/less frequent - lumbar division (31.80/o) and considerably thinner/less frequent - with the wound of the neck division of spine (5.20/o). On the neurologic syndrome in this case absolutely predominated the cases of the full/total/complete violation of the conductivity of spinal cord or horse tail, while according to the character/nature of wound - penetrating wounds of spine. It is necessary to note that in



the latter/last group the bedsores more frequently were encountered with the blind-end wounds of spine (48.80/o), that one should explain, apparently by the stimulation of the sympathetic education of spinal cord by foreign body.

With the penetrating wounds with the heavy damage of spinal cord the bedsores developed into 1/4 cases in the first 2 weeks, counting from the moment/torque of wound. Among dead into 20.00/o cases the bedsores served as the source of sepsis and death.

The pathogenesis of bedsores cannot be considered as the finally explained.

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However, Soviet neurosurgeons' majority considers their not as stoppage the consequence of prolonged pressure in the anesthetized sectors of skin, but as the result of stimulation or damaging the vegetative nervous system. In this respect the pressure of bed in the sectors of body with the smallest layer of soft tissues (rump, greater trochanter, etc.) has only provoking value.

Special interest are of observations of the development of bedsores in the cases of wounds with the neurologic manifestations in

the form of paralysis of Brown-Sekar. Bedsores with this more frequently appeared isolated/insulated on the side of paralysis.

G. obtained 10/VIII 1944 the perforating wound of neck with the tangential penetrating wound of spine at the level of the IV-VI neck vertebra and the contusion of spinal cord at this level. Initial quadraplegia to the 4th day was changed into Brown-Sekar syndrome with the preponderance of motor fallouts to the right (right hemiplegia) with the violation of surface sensitivity to the left.

1/IX 1944 was opened/discovered a deep bed sore in sacral-buttock region to the right, that penetrates before the bone. Attention is drawn to a strict limitation of bed sore along the center line. Integuments in the left buttock region remained normal, although the patient lay/rested at the position/situation on the spine on the air separating flask.

24/IX with laminectomy are discovered the fragments of the right half small arcs of the VI and VII neck vertebra, which were incorporated in the right half spinal canal, without the damage of solid cerebral shell. After operation/process and supplementary blockade with novocaine of the zone of the second, third and fourth right thoracic ganglion/node of frontier sympathetic shaft the bed sore rapidly was cleared and cicatrized.

3 Years after operation/process he works house by cobbler. Much sits. The syndrome of Brown-Sekar remained, although in the weakened form/species, nevertheless there are no bedsores. Evidently, together with operation/process and removal/distance of bone fragments from the spinal canal was removed the source of the stimulation of the vegetative nervous system.

Considerably less frequent it was possible to meet in the cases of Brown-Sekar paralysis the onset of bedsores isolated/insulated on the side of the fallout of surface sensitivity, as this shows the following observation.

D. obtained 29/VIII 1944 the perforating bullet wound of neck with the tangential penetrating wound of spine at the level of the V and VI neck vertebra and contusions of spinal cord at this level. After wound arose Brown-Sekar paralysis with the preponderance of motor violations to the left and the fallout of surface sensitivity to the right. Bedsores developed isolated/insulated in the right buttock region in large trochanter and in external malleolus of right lower extremity. Patient lay/rested always on the spin on rubber air mattress.

Thus, for the onset of bedsores it is insufficient the presence of paralysis or fallout of sensitivity. For this are necessary the implication in the process and vegetative nervous systems by overstimulation of central nervous system in its highest floors to the cortex of the hemispheres of brain inclusively and a change of the metabolic processes in the tissues of the corresponding region.

Prophylaxis of bedsores. Besides the special measures for the arrangement of casualties, was applied the wiping of skin by camphor alcohol two times; sometimes it they replaced by 0.25-0.50/o solution of ammonium hydroxide.

Very high value has dry bed, frequent exchange of bed and next to the skin linen, and also underlayer of the sheet above the oil cloth without any folds.

Treatment of bedsores. In the cases of the already emergent bedsores in the Great Patriotic War it was applied physiotherapy, chemotherapy and surgical methods of treatment.

Physical therapy of bedsores. Most extensively was used ultraviolet lighting of bedsores.

In connection with the fact that the photo-reactivity of skin in those wounded the spine is very lowered in the paralyzed divisions, and the effect of ultraviolet lighting was noted only during the manifestation at least of weak erythema in the surrounding skin (L. N. Startseva), doses varied from 100 to 1000 units. By irradiation it was sometimes possible to arrest hardly the planned bed sore in the form of red or cyanotic macula on the skin hardly by noticeable infiltrate in this region. However, the disappearance of this macula did not eliminate the development of bed sore subsequently, especially with the cross interruption of spinal cord. During the treatment of bed sore in the second phase its developments - with the exfoliation of epithelium, with the considerable infiltration of the underlying tissues - applied the erythematous doses of ultraviolet rays. And in these cases the course of bed sores was different, depending on the severity of the damage of spinal cord. With the partial interruption of spinal cord under the effect of ultraviolet lighting after only several days was distinctly visible the expressed demarcation line by drying of bed sore on the spot for the exfoliation of epithelium and with the rapid education of scab, and also with the disappearance of inflammatory reaction in the periphery.

In the favorable cases through several days the scab dropped

off, and under it was opened/disclosed by unit the epithelialized surface, granulations appeared rose-colored, fine-grained, and bedsores rapidly was decreased.

Irradiation was continued at the doses of 100 units in a day/every other day to the full/total/complete healing of bedsores. In the cases of the cross interruption of spinal cord sometimes the unit of the bedsores was cleaned and even it was occluded, but appeared bedsores in the neighborhood or recurred previous.

In the cases of the development of sepsis ultraviolet lighting remained unsuccessful in connection with the full/total/complete absence of the photo-reactivity of skin and reactivity of organism generally.

Consequently, ultraviolet therapy detained the process of decomposing/decaying the tissues and an increase in bedsores, and during the reversible damages of spinal cord the disrupted trophic system was restored earlier than bedsores it could serve as the source of the onset of sepsis.

The use/application of hypertonic solutions of common salt and even bandages with the ointment of A. V. <sup>shneravskiy</sup> ~~Vishnovskiy~~ or with the fish oil, according to the data of the personal observations of <sup>ye</sup> ~~of~~ T.

Zalkindson, L. N. Startsevoy et al., did not impede conducting ultraviolet lighting. Before the procedure the ointment usually was removed/taken in the medical dressing room. Did not impede the effective conducting of ultraviolet lighting and the education of scab on the surface of bedsores.

Ultraviolet lighting of bedsores contributed to the acceleration of the demarcation of necrotic tissues, to the decrease of local inflammatory edema, to drying the getting wet surface of bed sore and to rapid education of scab with an increase in the granulations under it.

It is not possible to underestimate the value of scab (if under it there is no accumulation of pus) and in the economy of protein metabolism/exchange, in particular, the consumption of protein, connected with the decomposition/decay of tissues and the large loss of tissue fluid/liquid and lymph through the gaping humid surfaces of bedsores.

Under the favorable conditions individual neurosurgeons did not reject the use/application of warm water baths for accelerating the rejection/separation of necrotic tissues.

The medicinal treatment of bedsores carried purely local

character/nature and it was similar to the treatment of suppurative wounds.

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At different fronts extensively used bandages with the antiseptics and the hypertonic solutions, and also balsam bandages (ointment of A. V. Vishnyevskiy, P. G. Korneva). With deep bedsores with the exposure of bone favorable impression left local use/application of 10-20o/o of solution of creolin, and also 1o/o of solution of methylene blue or potassium permanganate. Clear effect from the local use/application of sulfanilamides in the powder it is not noted.

Together with the local treatment of bedsores, the very importantly over-all strengthening treatment (toning substances, fractional blood transfusions, vitaminization, increase in the food of the content of the easily available protein, etc.).

Some neurosurgeons for the treatment of bedsores applied the appropriate bacteriophage after the preliminary bacteriological investigation of microflora of bed sore. N. I. Grashchenkov noted in this case the rapid rejection/separation of necrotic tissues and the cicatrization of bed sore.



Surgical methods of the treatment of bedsores. Together with the physiotherapy by drug treatment had vital importance the surgical methods of the treatment of bedsores in connection with the early education of scab and the decomposition/decay of the deeply lying/horizontal tissues, with the accumulation of pus under it and the formation of purulent flows. The timely separation/section of scab and the carving of the necrotized tissues facilitated access physically and the chemical agents of treatment (ultraviolet rays, etc.) to deep divisions of bedsores, decreased the intoxication and the possibility of the onset of septic process. Such nonvital tissues cut all over on the boundary of healthy/sound tissues. The timely removal/distance of the necrotized tissues frequently accelerated the healing of bedsores.

Besides the given methods of the treatment of bedsores, according to data of A. N. Bakulev and D. G. Goldberg, successfully was applied the novocaine blockade (are repeated 4-5 times after 1-3 days) of the second and third lumbar ganglion/node of frontier shaft either near-kidney cellulose with the wound of lower-thoracic and lumbar division of spine, or second, third and fourth thoracic ganglion/node with the wound of the neck division of spine.

S. obtained 29/V 1944 the perforating bullet wound of chest with the penetrating wound of spine at the level of the XII thoracic

vertebra and the syndrome of the full/total/complete violation of the conductivity of spinal cord at the level of the first and second lumbar segment.

Wound was complicated by the heavy form of cystopyelonephritis, by right pneumonia and extensive bedsores, which occupied the region of rump and partially nates. The decomposition/decay of tissues in the bedsores rapidly progressed, in spite of the use of rubber air mattress, physiotherapy and over-all strengthening treatment. The twofold introduction of 10/o novocaine (on 30 cm<sup>3</sup> in a day/every other day) to the left into the zone of second-third lumbar ganglion/node led to the drying of the left half bedsore with the boundary almost strictly along the center line where paused itself the decomposition/decay of tissues, and this unit of bedsore was covered seemingly dull film.

Sometimes of the extensive and slowly cicatrizing bedsores (with the satisfactory general condition of casualty and the favorable prognosis in the relation to the function of spinal cord) in the late period was applied the plastic occlusion of bedsore by free transplant according to Turkish or transfer of graft/flap on the pedicle, especially with the bedsores on the thigh. However, this plate frequently remained unsuccessful due to the numbness of grafted/transplanted rags. Neurosurgeons' experience in the treatment

of bedsores in the Great Patriotic War attests to the fact that in the majority of the cases was conducted the conservative treatment of bedsores with the utilization of the mentioned substances both of local (to the bedsore) and general/common/total (to the organism) action.

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It is noted, that the course of bedsore frequently noticeably was improved after operation/process on the spine and the spinal cord, even with the full/total/complete interruption of spinal cord.

The latter fact with the sufficient persuasiveness testifies about the role of central nervous system (cerebral cortex of brain) in the pathogenesis of bedsores. From the presented fact it follows that for onset and development of bedsore it is insufficient the damage of spinal cord to one or the other degree. It is known that the anatomical damage of spinal cord remains also after operation/process; however, bedsores heal, if operationally to eliminate the factors, which support the stimulation of central nervous system from the focus of damage (scars, bone fragments, foreign bodies, etc.), and thereby it is possible to remove the flow of pathological impulses/moments/pulses on the periphery of the cerebral cortex, which control metabolism in the tissues.

Other violations of the integuments of dystrophic character/nature, which were being observed in those wounded into the spine predominantly in the late and residual period, became apparent in the form of ulceration/pitting on the skin (Fig. 109) and hyperkeratoses (Fig. 110) which were noted predominantly with the wounds at the level of horse tail.

In light of the aforesaid above about the nature of the violations of trophic system in the tissues of the paralyzed divisions it becomes clear that for the treatment of similar complications it usually proved to be insufficient local action in the form of the carving of hyperostoses, plastics, physiotherapy, novocaine blockade, etc.

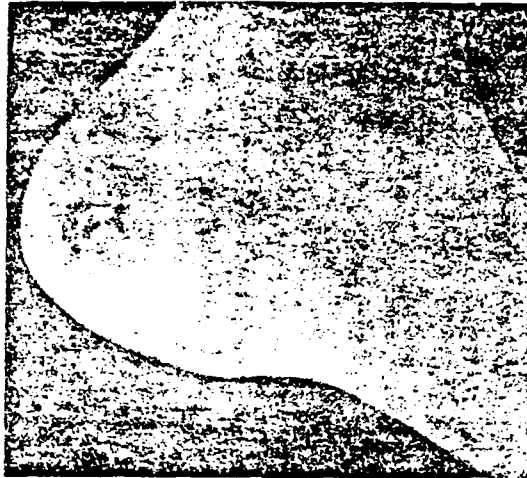


Fig. 109. Trophic ulcer in the heel region of the afterward blind-end fragmentation penetrating wound of spine with the damage of horse tail.

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More effective was late primary or repeated laminectomy with the removal/distance of tunicary intergrowth, cysts, of callus and the like (S. I. Zdrilyuk, A. Yu. Sozon-Yaroshev), and also sympathectomy with the direct favorable outcome (A. V. Bondarchuk, I. M. Grigorovskiy). Edemas of the paralyzed extremities, caused by the disorder of their vascular innervation, usually were weakly subjected to symptomatic treatment (mercusal in combination with the limitation of the reception/procedure of fluid/liquid, heart substances, elevated position/situation of extremities, etc.). If matter did not

reach the full/total/complete transverse contamination of spinal cord, positive effect usually exerted early laminectomy. Upon the full/total/complete transverse contaminations of spinal cord all measures proved to be without results.

Pneumonia. Pneumonia was one of the frequent and most terrible complications of the bullet wounds of spine and spinal cord. Based on materials of the protocols of autopsies and reports of PAL, from a total number dead of those wounded the spine it died of pneumonia 9.0o/o in the army area <sup>Kh</sup> (PPG), in the hospitals of the front area - 6.6o/o. From the dead persons during the transportation on the evacuation routes into the front line area it died of pneumonia 16.6o/o.

The frequency of pneumonia, depending on the level of the wound of the spine, is represented in Table 45.

From the given numerals it is evident that by pneumonia were most frequently complicated the penetrating wounds of spine and spinal cord in neck (12.2o/o) and thoracic division (10.0o/o).



Fig. 110. Hyperkeratosis in the form of the spur of the afterward blind-end fracture penetrating wound of spine with the damage of horse tail.

Table 45. Frequency of the development of pneumonia and level of the wound of spine and spinal cord (in the percentages).

(1) Частота пневмоний	(2) Уровень ранения		
	(3) шейный отдел	(4) грудной отдел	(5) пояснично- крестцовый отдел
(6) По отношению ко всем проникающим ране- ниям позвоночника	12,2	10,0	5,7

Key: (1). Frequency of pneumonia. (2). Level of wound. (3). neck

division. (4). thoracic division. (5). Sacral-lumbar division. (6).  
With respect to all penetrating wounds of spine.

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According to the data of the development of the histories of disease/sickness/illness/malady, among all dead those wounded the spine pneumonia as the reason for death is noted into 4.80/o; of them with the wound of neck division in 8.60/o, that of thoracic division - into 6.20/o and sacral-lumbar division - 1.90/o.

During the analysis of data of autopsies based on materials of the neuro-surgical center of Leningrad Front, it can be in connection with the special feature/peculiarity of the conditions, connected with the blockade of city, into 28.00/o of cases it was possible to recognize as the reason for death pneumonia; in the less heavy form pneumonia was encountered considerably more frequent as the satellite of other complications (A. A. Kulikovskaya, T. S. Istamanova).

According to the investigations by T. S. Istamanova, pneumonia complicated the wounds of spine 4 times more frequently than maxillofacial, 5 times it is more frequently than craniocerebral wounds, and 16 times it is more frequently than the wound of extremities and pelvis, moreover in her investigations T. S.



Istamanova excluded the wounds of spine, which are combined with the penetrating wounds of chest. The reason for this frequency of pneumonia with the wounds of spine with the damage of spinal cord should be considered the specific violations of respiration, connected with paralysis with appropriate of muscles. As the confirmation of this can serve the comparison of the frequency of the complications of pneumonia on different levels of the wound of spine. In the majority of the cases pneumonia was bilateral.

According to the observations of T. S. Istamanova, about 80.00/o of casualties with the damage of the neck and thoracic division of spinal cord noted in early first days of wound painful subjective perceptions in the form of "air deficiency", connected with the difficulty respirations; respiration became surface and hoarse. To this frequently was connected the difficult expectoration of mucus; the attempt to clear the throat mucus rather resembled choking, which did not lead to the desired result. In this phase of suffering still neither clinically nor roentgenologically it was the possible to establish/install inflammatory focus in the lungs, but after only several days clinically in such casualties was defined diffuse bronchitis, which it was possible to consider as the manifestation of the delay of mucus as a result of the difficulty of its expectoration. On the 10-15th day after wound in similar cases clinically were determined the lines of fine focal/acinous

bronchopneumonia, predominantly in the lower fractions, from both sides, and roentgenologically - small foci of the infiltration of pulmonary tissue, in the lower divisions.

The accumulation of viscous mucus in the lumen of bronchi caused the occlusion of fine/small bronchi with subsequent atelectasis of the small sectors of the lungs, which contributed to penetration and dissemination of infection on the pulmonary tissue.

It is doubtless, to the development of pneumonia in those wounded the spine contributed the factor of cooling, since suddenly developed after the wound of spine paralyses of the lower extremities completely incapacitated casualties. However, one this factor it was insufficient for the onset of pneumonia. Stilbs this testifies the explicit preponderance of the complications of pneumonia among the casualties with the damage/defeat of the neck and thoracic division of spine in comparison with a quantity of these complications with the wound of sacral-lumbar division or with the wound of thighs and other regions of the body, incapacitated casualties on the field of battle.

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This gave T. S. Istamanova occasion from the point of view of

pathogenetic classification to relate pneumonia in the wounded into the spine to the group pulmonary complications, which developed as the consequence of the disrupted mechanism of respiration (paralytic pneumonia), and pneumonia of terminal period in them - to the hypostatic.

In 20.00/o of T. S. Istamanova's cases were discovered large-focus pneumonia, usually established during the first days after wound. The mechanism of this form of pneumonia in those wounded the spine therapists see in the contusion of chest with the sectors of hemorrhage into the pulmonary tissue. Usually in them after wound was observed short-time hemoptysis in the absence of indications of the penetrating wound of chest. Such forms of pneumonia flowed/occurred/lasted more frequently favorably, being permitted with the usual therapy already in the early period after wound.

Less frequent these forms of pneumonia carried the progressive character/nature; the dissemination of pneumonia occurred by merging of separate foci and capture of the new sectors of pulmonary tissue or to the available foci of pneumonia were connected the grown on stagnant phenomena in the lungs, which were being frequently finished with pulmonary edema with the fatal result.

These clinical observations were confirmed also by data of autopsy and histological study. On the autopsy usually in similar cases they were noted in the light expressed stagnant phenomena and sharp venous plethora, and frequently also the swelling of pulmonary tissue. Against this background were determined the fine focal/acinous, partially drainage pneumonic sectors, which occupied, as a rule, both lower fractions/portions with the hemorrhagic or pyo-catarrrhal exudate. Histologically it was possible to establish that the inflammatory infiltration was arranged/located predominantly around the bronchi (T. S. Istamanova, A. A. Kulikovskaya, Ye. A. Uspenskiy).

Everything said determined to a certain extent prophylaxis of pneumonia in those wounded the spine with the damage of spinal cord.

Such casualties should have been contained in by heat, the well ventilated quarters/premises. For prophylaxis of hypo-static phenomena in the light ones and the delays of mucus in the bronchi was applied frequently the change in the position/situation of casualties in the bed. To reinforcing of respiration and to improvement in the ventilation of the lungs contributed the wide application of therapeutic gymnastics in the form of special exercises with the utilization of auxiliary respiratory/breathing muscles of neck, shoulder belt/zone and abdominal press. For exciting

the autonomous spinal centers of respiration was recommended the inhalation of carbonic acid in the considerable concentration.

For the rarefaction and the best expectoration of mucus doctors' majority assigned different expectorants. In combination with the enumerated substances proved to be highly efficient the use/application of sulfanilamides, which considerably lowered mortality from pneumonia.

Peritonitis and pseudo-peritonitis. Weakening the peristalsis of gastrointestinal tract, local and overall meteorism with the phenomena of paralytic impassability, of the muscle tensions of abdominal press frequently were observed with the wounds of spine and spinal cord.

The clinical picture of peritonitis is noted into 21.00/o to a total number of those wounded in the region of lower-thoracic or lumbar-sacral division of spine. With the explicit signs the wounds of the organs/controls of the abdominal area of casualties operated.

Considerable difficulties in the relation to of diagnosis and treatment presented complications from the side of peritoneum and organs/controls of abdominal area in those wounded the spine and the spinal cord without the clear signs of the wound of the

organs/controls of abdominal area.

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In the sharp/acute and early period of wound, especially lower-thoracic and lumbar division of spine, as a result of the stimulation of frontier sympathetic shaft and its ganglia/nodes by retroperitoneal hematoma, frequently appeared the clinical picture of peritonitis or acute obstruction, which in cases when it is not possible to establish/install the direction of wound canal, impelled surgeons to explorative laparotomy/celiotomy. Clinically in this case sharply appeared swelling/distension of stomach as a result of paralysis of intestine, with the delay of chair/stool (and of urine) and stopping of the departure/separation of gases. Frequently in this case was observed the sharp muscle tension of abdominal wall, repeated vomiting, frequent, small pulse with a drop in the blood pressure, intensive thirst, frequent shallow breathing, pale, growing thin face, sometimes appeared cold perspiration. If moreover, wound canal went towards abdominal area, then became clear the assumption of the possibility of the penetrating wound into the latter. The analysis of the blood in similar cases did not help the accomplishment of diagnostic mission. It should be noted that, according to the observations of the individual surgeons, with the clinical picture of peritonitis, but without the damage of the

organs/controls of abdominal area, very frequently was not noted the frequency increases of pulse (V. A. Zhmur).

Based on materials of GBF of Leningrad Front, with the described syndrome into 1/4 cases was produced the laparotomy/ceiotomy in the foremost stages. Similar numerals are noted by A. S. Orlovskiy, M. K. Brotman, Ye. Ya. Briskman and M. P. Postolov according to the observations at other fronts. Only in the single cases in this case was discovered in the abdominal area a blood-containing exudate or an insignificant quantity of free blood. M. P. Postolov observed on DMP of those wounded the lumbar division of spine, in which to the second day after wound developed the severe pains in the abdominal area, the stress/voltage of abdominal muscles, the symptom of Blumberg-Shchetkina. During laparotomy the diagnosis was confirmed not in one case - the damage of internal organs/controls was not discovered. Subsequently of pain in the abdominal area they calmed down.

This pseudo-peritoneal syndrome was held usually 2-5 days and during the favorable course gradually was smoothed.

As showed experiment/experience, in those wounded into the spine even the penetrating wounds into the abdominal area with the damage of intestine, parenchymatous organs/controls and the like

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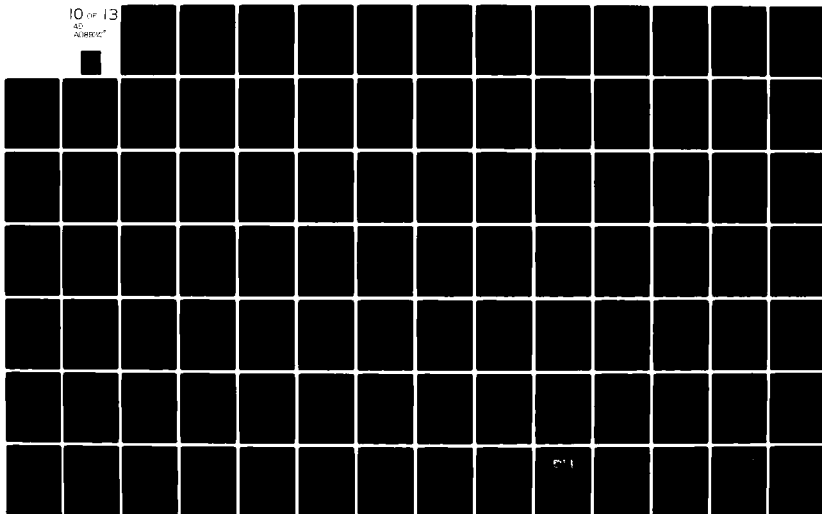
FOREIGN TECHNOLOGY DIV WRIGHT-PATTERSON AFB OH F/G 6/5  
EXPERIENCE OF SOVIET MEDICINE IN A GREAT PATRIOTIC WAR 1941-194--ETC(U)  
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flowed/occurred/lasted without the reaction from the side of peritoneum in the cases of the heavy damage of spinal cord in the average/mean and upper-thoracic division.

Asymptomatically flowed/occurred/lasted also peritonitis, which appeared on the soil of the perforation of the bladder (with ulcerous-necrotic cystitis) in those wounded into the spine, especially in the weakened casualties, against the background of other complications as meningitis, pyelonephritis, pneumonia, etc.

N. obtained 17/I 1944 blind fragmentation penetrating wound of the left half chest and the tangential penetrating wound of spine at the level of the VII thoracic vertebra with the full/total/complete violation of the conductivity of spinal cord at the level of the eighth thoracic segment. Wound was complicated by bilateral pleural pneumonia and cysto-pyelonephritis.

30/I 1944 it entered into evacuation hospital of GBF in the severe condition, inoperable. 10/II it passed away (on 24th day after wound). On the autopsy is discovered the cross softening of spinal cord at the level of the VII-VIII thoracic vertebra: the wound of the lower fraction/portion of left lung. Necrotic ulcerous cystitis with the perforation into the abdominal area, spilled suppurative peritonitis, pyelonephritis, bilateral pleuropneumonia. Reason for

death - peritonitis.

With the life of the casualty neither of subjective complaints nor objective signs of peritonitis it was. In particular, stomach remained soft, painless with palpations, it was not the vomiting and other symptoms of the stimulation of peritoneum.

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In similar cases peritonitis was more frequently determined only on the sectional table. During the low wounds of spine and the moderate/mild damage of spinal cord or rootlets of horse tail it was possible to note typical for peritonitis symptoms with the appropriate painful, reflector and shielding reaction.

All special features/peculiarities of the clinical course of peritonitis and pseudo-peritonitis indicated in those wounded the spine during the entire Great Patriotic War attracted the attention of the doctors in attendance. In proportion to gaining of experience markedly was shortened a number of explorative laparotomies/celiotomies.

However, in the presence of solid suspicions to the penetrating wound of the abdominal area of casualties they operated already in

the army area (DMP, WPPG of the first line).

Suppurative infection of wound.

The suppurative infection of wound frequently became the source of the infection of spine, spinal cord and its shells.

Based on materials of the development of the histories of disease/sickness/illness/malady, the suppurative infection of wounds is noted with the penetrating wounds into 12.90/o, and with the nonpenetrating ones - into 21.90/o.

The radical surgical processing of wound in the foremost stages of evacuation rarely could be realized. The majority of casualties, as it is said above, entered the specialized hospitals with the more or less extensive wounds either after the dissection, produced in the army area or as a result of the very mechanism of wound. Such wounds were the object/subject of the special attention of the doctors in attendance, and for the acceleration their healings in the evacuation hospitals applied different substances.

Extensively were used different forms/species of physiotherapy in combination with the antiseptics (sulfanilamides), and toward the end of the war - with the antibiotics. Neurosurgeons' unit considered

advisable reworking of wounds even with the anechoic suture after the admission of casualties into the specialized hospital through the week and it is later after wound (A. N. Bakulev). Since 1943 comparatively extensively were used primary-deferred and late, secondary sutures to the wound (S. I. Banaytis, M. N. Yelanskiy, P. A. Kupryanov).

From the physical therapy methods of treatment widest use obtained ultraviolet lighting of wound.

Under the favorable conditions, after the full/total/complete cleansing of wound from the necrotic tissues and the abatement of inflammatory phenomena, for the stimulation of granulation and epithelization of wound were applied the small doses of ultraviolet rays in combination with the ionophoresis with potassium iodide.

Under these conditions, as showed experiment/experience, the healing of wounds in those obtained the wound of spine flowed/occurred/lasted more rapidly (L. N. Startseva).

Locally applied sulfanilamides, in the form of powder or emulsions, in particular, reversible emulsions, the corresponding phages and gramicidin, that accelerated an increase in the granulations, cleansing and healing of wounds S. I. Banaytis, N. I.

Grashchenkov).

As the over-all strengthening and stimulating treatment applied the fractional blood transfusions, the vitaminization of casualty, etc.

Most essential in treatment and warning/prevention of complications from the side of wound remained their radical early primary or repeated surgical processing.

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Anaerobic infection. If the surgical processing of wounds they did not produce or produced insufficiently radically, frequent complication was anaerobic infection. Based on materials of the development of the histories of disease/sickness/illness/malady, among unoperated those wounded the spine anaerobic infection is noted into 1.10/o of cases.

Anaerobic infection in those wounded the spine sometimes was determined with the retardation, especially if it appeared in the paralyzed divisions of body against the background of the full/total/complete violation of the conductivity of spinal cord. In this case an increase in the volume of extremities they sometimes

accepted as edema (one of the frequent symptoms of the full/total/complete violation of the conductivity of spinal cord).

Usually the source of anaerobic infection were the unfinished wounds, the especially lumbar, buttock regions and the lower extremities. Sometimes the outbreak of anaerobic infection could be related due to osteomyelitic focus in the spine. In certain cases anaerobic infection appeared from the bedsore.

N. received 13/IV 1942 the blind-end fragmentation penetrating wound of spine at the level of the XII thoracic vertebra with the syndrome of the full/total/complete violation of the conductivity of spinal cord at the level of the twelfth thoracic segment.

In connection with the heavy condition of casualty (pneumonia) him they did not operate. Rapidly arose extensive bedsores in the sacral region and in large trochanters of both thighs; cystitis with hematuria, then pyelonephritis. On the 55th day flamed up anaerobic infection (oedematiens) in the buttock region, in the juxtaposition with the bedsore, which was rapidly disseminated to the lower extremities and the body. Serious treatment, as extensive dissections, remained unsuccessful.

30/IX 1942 (on the 60th day after wound) casualty it perished

from anaerobic censis, which clearly arose from the bedsore in sacral-buttock region.

Bacteriology of wounds. During the bacteriological investigation of wounds N. V. Kryzhanovskaya (GBF, 1943) more frequently found hemolytic streptococcus in the association with staphylococcus and by gram-positive bacillus from the group of diphteroid; more rarely was connected gram-negative bacillus from the group of Proteus. In a number of cases in the wounds was discovered Staphylococcus aureus in the association with bacillus/rod of blue-green pus and gram-positive or gram-negative bacillus. This microflora completely corresponded to the course of the wounds whose suppurative discharge was insignificant or wound was found in the phase of granulation. Repeated experiments usually detected the same microflora with a comparatively small quantity of microbes of rotting group. N. V. Kryzhanovskaya could not note the effect of the violations of trophic system on the course of anaerobic infection. P. P. <sup>sk</sup>Saxarov established that in the bacteriological picture of the wounds of spine predominated anaerobes and aerobic flora. Of the anaerobes more frequently were encountered the microbes of the type of drum bacillus/rod, Cl tetanmogrophus, Cl putrificus, and also anaerobic streptococcus, Proteus and bacillus/rod of blue-green pus. Rotting flora, in his opinion, reflected the flaccid course of wound.

The percentage of the pathogenic anaerobes between the 20th and 30th day descended to 10-15 and was held at this level to 2 months and more. Rotting microbes (aerobes and anaerobes) also long were detained in the wound.

This special feature/peculiarity N. I. Grashchenkov counts specific and inherent only to the wounds of spine. The pure/clean cultures of pathogenic microbes, isolated by <sup>1/2</sup> E. I. Gudkova with the wounds of spine, proved to be highly virulent.

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This gave N. I. Grashchenkov the foundation for assuming that the issue of wound depends not only on the severity of wound, but also on the infection, connected with the specific flora of wounds, and the association of microbes in them. According to these data, with the wounds, infected with pathogenic anaerobes, lethal outcomes are noted by N. I. Grashchenkov into 23.00/o of cases; with those infected with the rotting anaerobes (in the absence of pathogenic anaerobes) respectively - into 17.90/o, by hemolytic streptococcus - into 12.50/o and by rotting aerobes (Proteus) - into 11.40/o of cases.

The same laws governing the complex association of microbes are obtained in the cases of the infection of bedsores and urine during



the outbreak of infection in the urinary tracts. These facts, extracted in the Great Patriotic War, impelled surgeons to give to the microflora of wounds with the bullet wounds of spine larger attention than this was done earlier, and to resort to earlier surgical intervention with the use/application of active bacteriostatic and bactericidal substances.

The latter acquired special importance in light of the investigations by <sup>Ye</sup>E. I. Gudkova, who established, that the immunological activity of the blood serum of those wounded into the spine for a long time remained in the limits of the extremely low titers, which do not exceed for anaerobes 1:10 and for staphylococcus 1:100, which indicated the depression of immunological reactions in casualties.

This fact underscored N. V. Kryzhanovskaya, who established, that under the condition for weakening organism even low-activity under normal conditions flora becomes virulent. At the same time was noted the unusually flaccid course of infectious processes in the tissues of those wounded the spine. Each neurosurgeon, which observed such casualties, noted that sometimes the casualties with the very disseminated infected wounds and the bedsores lived on 2-3 months with the subfebrile temperature or even hypothermia and moderate or considerable leukocytosis with the shift/shear of formula to the

left. Only into the latter to the apparitor of life the reactivity of organism finally fell.

Each observed those wounded the spine saw that with the in proper time taken energetic measures the reverse development of infectious process and the reduction of the functions of spinal cord frequently proved to be possible even in such cases in which previously occurred far visited complications.

#### Osteomyelitis<sup>1</sup>.

FOOTNOTE <sup>1</sup>. Candidate of medical sciences docent D. G. Gol'dberg and doctor of medical sciences M. S. Kosinskaya. ENDFOOTNOTE.

Osteomyelitis of spine with the bullet wounds was observed, according to the materials of the development of the histories of disease/sickness/illness/malady, into 14.1o/o (6.9o/o with those penetrating and 21.7o/o with the nonpenetrating wounds).

Localization of osteomyelitis of spine is visible from Table 46.

From Table 46 it is evident that most frequently osteomyelitic processes were developed after the wound of lumbar-sacral division of spine.

In contrast to hematogenic osteomyelitis, which are observed in peacetime when are destroyed predominantly extensions and small arcs of vertebrae, the complication of osteomyelitis with the bullet wounds of spine more frequently connected with the damage of the bodies of the vertebrae, rich in porous substance. More rarely was observed the osteomyelitic process during the damage of the roots of small arcs and cross extensions with the transition of suppurative process to the body of vertebrae. With the fragmentation wounds the complications by osteomyelitis are noted into two and the more of times more frequently than with the bullet ones. Thus, with the bullet wounds of spine osteomyelitis were encountered into 28.80/o, with the fragmentation ones - into 64.80/o and with other wounds - into 6.40/o.

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Of 75 cases of osteomyelitis, observed by T. M. Gachkina (GBF, 1943), osteomyelitis bodies of vertebrae was encountered in 58 cases, and small arcs and extensions - in 17 cases. According by obtained by it data, osteomyelitis was more frequently destroyed the lumbar division of spine and rump, which is evident from Table 47.

This frequency of osteomyelitis of lumbar-sacral division depends on the riches of rump by the porous substance, easily beaten with infection, and also with considerable muscular array in the lumbar division, which impedes the sufficient draining of wound. Suppurative processes and suppurative flows in such cases contributed to the transition of infection to the adjacent bone divisions of spine. The large mobility of spine in the lumbar division, the considered by the individual authors as reason, which facilitates the development of osteomyelitis, hardly have vital importance. Comparatively rarely observed osteomyelitis of the thoracic division of spine can be explained by higher mortality in this group of casualties within the early periods when osteomyelitic process yet not have time to develop.

On the frequency of the complications of osteomyelitis had the most essential effect the character/nature of the primary processing of wound and the subsequent treatment. Osteomyelitis of spine more frequent was noted during the insufficient processing of wound or in the full/total/complete absence of processing.

Table 46. Localization of osteomyelitis and level of the wound of spine (in the percentages).

(1) Отдел позвоночника	(2) Частота ранения	(3) Частота остеомиелита	
		(4) к числу ранений данного уровня	(5) к общему числу остеомиелитов
(6) Шейный . . . . .	19,4	7,7	14,8
(7) Грудной . . . . .	38,2	5,6	20,0
(8) Пояснично-крестцовый	41,5	15,1	62,0
(9) Множественные ранения	0,4	13,6	3,2
(10) Всего . . . . .	100,0	14,1	100,0

Key: (1). Division of spine. (2). Frequency of wounds. (3). Frequency of osteomyelitis. (4). to number of wounds of this level. (5). to total number of osteomyelites. (6). Neck. (7). Thoracic. (8). Lumbar-sacral. (9). Multiple wounds. (10). In all.

Table 47. Distribution of osteomyelitis according to the divisions of spine (according to T. M. Gachkina) (in the percentages).

(1) Отдел позвоночника	(2) Частота ранений позвоночника	(3) Частота остеомиелита (по всем случаям остеомиелита)
(4) Шейный . . . . .	18,9	17,3
(5) Грудной . . . . .	38,1	8,0
(6) Поясничный . . . . .	37,1	49,4
(7) Крестцовый . . . . .	5,9	25,3
(8) Всего . . . . .	100,0	100,0

Key: (1). Division of spine. (2). Frequency of wounds of spine. (3). Frequency of osteomyelitis (to all cases of osteomyelitis). (4). Neck. (5). Thoracic. (6). Lumbar. (7). Sacral. (8). In all.

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In the lumbar division osteomyelitis more frequently was developed with the blind-end fragmentation wounds with the localization of fragments in the bodies of vertebrae and intervertebral disks. The ratio of perforating wounds to the blind ones can be expressed as 1:4.5. Osteomyelitis in the neck division of spine more frequently was observed with the combined wounds of spine and lower jaw from osteomyelitic focus in the latter.

Bullet osteomyelitis of spine was encountered more frequently with the nonpenetrating wounds of spine. It appeared predominantly with the wounds of the bodies of vertebrae.

Dynamic X-ray examinations showed that bullet osteomyelitis of the bodies of vertebrae flowed/occurred/lasted differently, depending on the condition of the small arcs of the corresponding vertebrae. If the small arcs of vertebrae were not substantially destroyed during the bullet wound, osteomyelitis, which appeared in the body of vertebra, usually led to its considerable destruction. Process frequently converted/transferred to the adjacent vertebrae and was

usually escorted/tracked by the compression of the body of one or several vertebrae. This compression in certain cases achieved the very considerable degree (Fig. 58 on pg. 146). Simultaneously with the development of the compression of the bodies of vertebrae was developed kyphotic bending of spine (Fig. 111).

In such all cases occurred the considerable infiltration of paravertebral soft tissues, which was being distinctly detected roentgenologically with the localization of process in the neck division of spine, and sometimes also in its thoracic and lumbar division. With all wounds of the front/leading divisions of neck vertebrae in the lateral X-ray photographs were distinctly visible changes in the prevertebral band of blackout. This band is the expression of soft tissue which are arranged/located between the nasopharynx, the larynx and the trachea, on one hand, and the spine - on the other hand. The blanket indicated under normal conditions has a specific width and a form (Fig. 66 on pg. 152). with the bullet wounds this band at the appropriate level was expanded, was strained and it sometimes acquired uneven outlines. During the favorable course of wound these changes were gradually decreased, while during the development of osteomyelitis they grew on (Fig. 112). If pus broke through in to a swallow or the esophagus, the area of abscess penetrated the air. In such cases in the lateral X-ray photographs of neck distinctly was detected the image of the prevertebral abscess

(Fig. 113), and with series of studies were outlined its further changes.

Bullet osteomyelitis of spine flowed/occurred/lasted especially heavily and it is violent, if it was developed with the syndrome of the full/total/complete violation of the conductivity of spinal cord. This is explained, apparently by the presence of the deepest trophoneurotic changes.

With favorable outcome of osteomyelitis it was finished with the ankylosis of several deformed bodies of vertebrae. Simultaneously it appeared the more or less considerable calcification of front/leading longitudinal ligament disappeared the infiltration of paravertebral soft tissues.

If the described the osteomyelitic process destroyed the predominantly one half the body of spine, its cuneate compression could not advance and was developed only the more or less expressed scoliosis. However, the height of the corresponding disks in this case invariably/unchangedly descended. In such patients usually was observed the early considerable calcification of front/leading longitudinal ligament. During the favorable course of process after surgical intervention sometimes was observed the very rapid development of ankylosis and the education of the massive bone



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block/module/unit, which consisted of the bodies of two-three vertebrae (Fig. 114).

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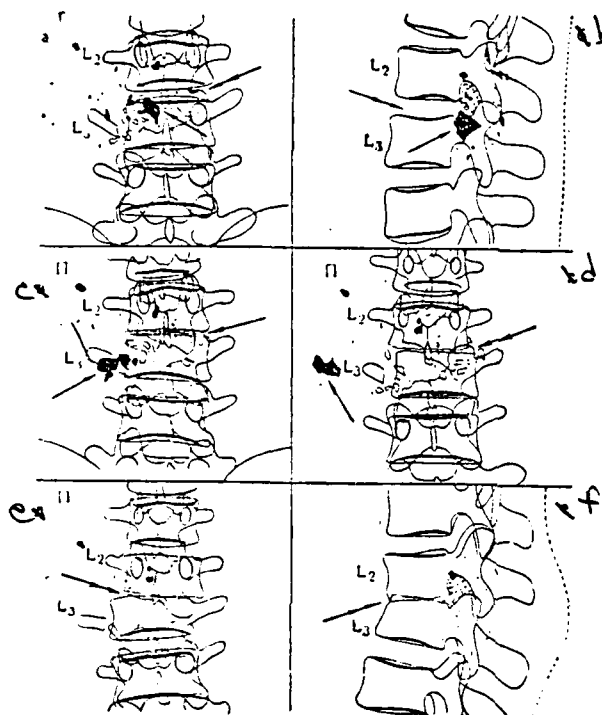


Fig. 111. Anatomical schemes from series of X-ray photographs of lumbar division of wounded L. Set's spine blind-end fragmentation wound of right half lumbar region to blind-end penetrating wounds of spine and 11 types horse tails at the level of III lumbar vertebra, by complicated osteomyelitis.

During the primary x-ray examination (a, b) in the right half spinal canal are discovered the multiple foreign bodies, which are arranged/located in the spinal canal and outside it in the soft

tissues of lumbar region. Foreign bodies were incorporated in the spinal canal through the right intervertebral joint between the II and III lumbar vertebra and into the right root of small arc of the III vertebra, after comminuting these sectors of spine. Break of the right cross extension of the III lumbar vertebra (a). Spinal canal at the level of the II and III lumbar vertebra is shaded (it is shaded in Fig. b). The height of the intervertebral disks is not lowered. During the repeated x-ray examination in 2 months (c) is discovered osteomyelitis of bodies of the II and III lumbar vertebra and small arc of the III lumbar vertebra. Destruction of adjacent closing plates of the bodies of these vertebrae and left root of small arc of the III lumbar vertebra. The height of the corresponding intervertebral disk sharply was lowered. Occurred the displacement of two large/coarse foreign bodies, which were being located in the spinal canal. These foreign bodies were secreted from the spinal canal and they are arranged/located to the right from the spine. This transfer of foreign bodies testifies about the penetration of pus to the right from the spine. During the following x-ray examination 3 months after wound (d) is discovered the continuous transfer of foreign bodies the to the right and limply progressive destruction of the adjacent divisions of bodies of the II and III lumbar vertebra. The corresponding disk almost completely disappeared. The caudal division of spine at this level was insignificantly displaced to the left. The fourth X-ray investigation (e and f) is produced 5 months

after the wound when in the right half lumbar region arose the fistula, through which was secreted a considerable quantity of pus. During the x-ray examination it is established/installed, that the large/coarse foreign bodies were torn away with pus. Occurred the complete destruction of the intervertebral disk, which is located between the II and III lumbar vertebra. The caudal division of spine was displaced to the right (e); simultaneously occurred displacement at the angle, opened toward the front, in consequence of which was formed the kyphosis (f). in all figures both large/coarse foreign bodies are shown by arrows/pointers. Double arrows noted the region of disk, which is located between the II and III lumbar vertebra.

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Bullet osteomyelitis of the bodies of vertebrae flowed/occurred/lasted completely uniquely when during the wound occurred the complete destruction of the small arc of vertebra and corresponding ligamentous/connecting apparatus. Similar cases were observed only with the perforating penetrating wounds of spine and were characterized by the fact that the bodies of vertebrae were connected only with the aid of of the intervertebral disk. With the onset of osteomyelitis in such casualties occurred the rapid surface destruction of one closing plate of the body of one vertebra with the separation/section of disk. Because of this appeared the

full/total/complete disjunction of those lying above and below the divisions of spinal column at this level was developed the sharp subsequent displacement with the setting of different divisions of spine of one for another to height 1-1 1/2 vertebrae. In this case the caudal division of spine was usually displaced toward the front and upwards (Fig. 55 on pg. 143).

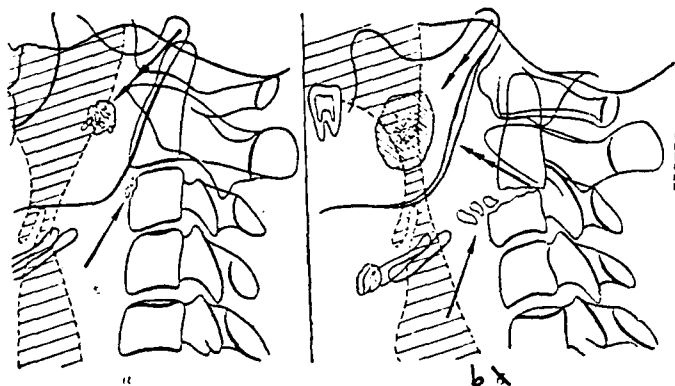


Fig. 112. Anatomical schemes from the X-ray photographs of the neck division of spine wounded g., the obtained through bullet wound face and the neck with wound of IV type spine, complicated osteomyelitis.

During the primary x-ray examination (a) is discovered the insignificant perforated defect in the middle of the right ascending branch of the lower jaw (it is densely shaded and shown by dual arrow/pointer), which contains the smallest bone fragments. Furthermore, is established/installed the tangential wound of the neck division of spine with the insignificant crushed break of the upper sector of the front face of body of the III neck vertebra (it is noted by arrow/pointer). Is revealed the considerable expansion of the prevertebral blanket, which indicates the presence of the infiltration of the vertebral blanket, which indicates the presence of the infiltration of the corresponding soft tissue (larynx and nasopharynx, that contain air, are widely shaded). In 2 months during

the repeated x-ray examination (b) is established/installed osteomyelitis of bodies of the II and III neck vertebra and right half lower jaw. In the region of the wound of lower jaw are discovered the symptoms of that growing on, osteolysis, due to what sharply it increased the defect of the bone (it is densely shaded and shown by dual arrow/pointer) and the symptoms of growing on osteonecrosis, due to what increased a quantity of bone fragments. Over the posterior surface of the ascending branch of lower jaw is outlined the scaled periostitis (it is designated by triple arrow/pointer). In the spine they are discovered: the destruction of the adjacent divisions of bodies II and III spine with a sharp reduction in the height of the corresponding intervertebral disk several fine/small sequestrations, which are torn away toward the front (they are noted by arrow/pointer). The expansion of the prevertebral blanket increased.

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Fig. 113. Anatomical scheme from X-ray photograph of neck division of spine wounded f. which obtained perforating bullet wound of neck, tangent to spine, with wound of front/leading division of body of IV type V neck vertebra, complicated osteomyelitis.

In the X-ray photograph, produced 1 1/2 years after wound, is detected osteomyelitis of bodies of the IV, V and VI neck vertebra. The external body of the vertebra is completely destroyed as adjacent disks. Between bodies of the IV and VI neck vertebra was formed wide bone ankylosis. There is a considerable destruction of body of the VI neck vertebra with several fine/small areas. Distinctly is outlined the fine/small sequestration, which was separated from body of the VI neck vertebra and which was displaced toward the front. Kyphosis of spine at this level. Calcification of the front/leading longitudinal ligament between bodies of the III, IV and VI neck vertebra. The



sharp expansion of the prevertebral darkening as a result of the massive infiltration of the soft tissues (image of the stenotic and displaced toward the front larynx is slantwise shaded). Is horizontally shaded and is shown with the arrow/pointer the image of considerable area, which is the behind gullet abscess, which burst open in to a swallow and filled up with air.

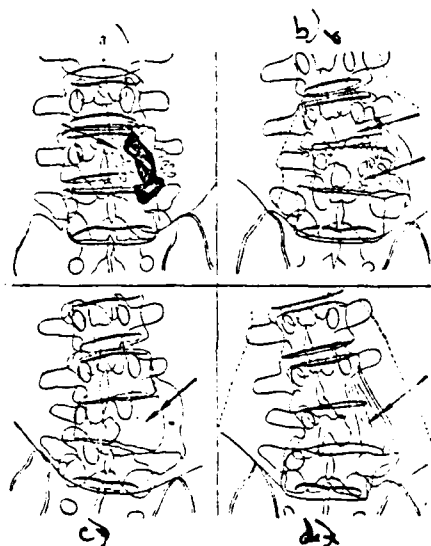


Fig. 114. Anatomical scheme from series of X-ray photographs of lumbar division of wounded S. Through spine bullet wound of left half lumbar region, tangent to spine, with wound of III type spine, complicated osteomyelitis.

During the primary x-ray examination (a) is discovered the crushed break of the left half small arc of the IV lumbar vertebra together with the root of the small arc (it is shown by arrow/pointer) and the lower joint extension. The zone of break applies to the adjacent

upper-external sector of body of the IV lumbar vertebra. The height of all disks is normal (intense image of the rubber drainage, introduced into the wound of soft tissues). In 1 1/2 months during the repeated x-ray examination (b) is established/installed osteomyelitis of bodies of the III, IV and V lumbar vertebra. Double arrows noted the extensive destruction of the entire left half body of the IV lumbar vertebra and considerable adjacent sector of the III lumbar vertebra. Furthermore, is a destruction of all adjacent surfaces of three vertebrae indicated and a sharp reduction in the height of the corresponding disks. Scoliosis by convexity to the left. The left half front/leading longitudinal ligament at this level is sharply moved aside by towards the outside saved pus and it is to a considerable extent calcified (a ilio-psoas sin is displaced to the left). During the third x-ray examination (c) 2 1/2 months after wound and after surgical intervention apropos of osteomyelitis is established/installed the almost full/total/complete absence of the left half body of the IV lumbar vertebra (region of defect is designated by dual arrow/pointer) and the adjacent division of body of the III lumbar vertebra. The calcification of the left half front/leading longitudinal ligament increased. During the fourth x-ray examination (d) 10 1/2 months after wound is discovered the wide bone ankylosis between bodies of the III, IV and V lumbar vertebra, with the considerable neoformation of bone tissue. The left half front/leading longitudinal ligament is completely ossified and

merged with the vertebrae indicated into the single bone array (this region was designated by dual arrow/pointer). Strain m ilio-psoas disappeared.

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If bullet osteomyelitis was developed when the incomplete, but nevertheless considerable destruction of the small arc of vertebra is present, sometimes simultaneously occurred the compression of the body of vertebra and the more or less considerable lateral displacement of the cranial division of spine with respect to the caudal. Analogous displacement could appear after laminectomy, produced in the presence of osteomyelitis, if after operation/process spine was not reliably fixed/recorded.

With the isolated/insulated bullet breaks of the roots of the small arc of vertebra frequently was observed the sufficiently rapid of the consolidation of their fragments. Osteomyelitis sufficiently rarely complicated these breaks. Usually in such cases there was a torpid inflammatory process which converted/transferred to the adjacent division of the body of vertebra and was escorted/tracked by the calcification of the corresponding sector of front/leading longitudinal ligament. Less frequently osteomyelitis, which was begun from the root of the small arc of vertebra, it led to the violation

of adjacent closing plates of the bodies of two-three vertebrae, and sometimes it was spread also to another root of small arc. In this case appeared the strains of spine and displacement of its different divisions.

The breaks of the posterior division of small arc were not usually complicated by osteomyelitis. When, in this division, a large quantity of fine/small bone fragments is present, the latter could be necrotized and supported festering wound. Osteomyelitic process in such cases did not arise. About this testified the absence of the progressive increase in the sizes/dimensions of the sector of the primary traumatic destruction of the small arc of vertebra. With fistulography distinctly it was obvious that the fistula course directly approached this sector.

With the blind-end wounds of spine, complicated by osteomyelitis, were observed the peculiar transfers of foreign bodies. Even foreign bodies, which were being located in the spinal canal, could be torn away from it together with pus, move at considerable distance and be secreted through the fistula (Fig. 111). Extremely high value has a locomotion of foreign bodies, which are located in the body of vertebra which occurs in proportion to the build-up/growth of destruction and compression of the latter, as a result of which the foreign body can move from the body of vertebra

into the spinal canal (Fig. 58 on pg. 146). In such cases occurred the abrupt changes in the contents of spinal canal. Are extremely risky the displacement of the foreign bodies, which tamp spinal artery.

With the bullet wounds of the intervertebral disks in the substance of the latter in the course of time it was possible to observe degenerate processes of the type of osteochondrosis. In this case occurred the complete destruction of the substance of disk which was determined roentgenologically as a result of a sharp reduction in the height of disk. with the blind-end wound of disk simultaneously with the decrease of its height was detected the transfer of the located in it foreign body, sometimes sufficiently considerable. In such cases in proportion to the decrease of the height of disk the foreign body began to be introduced in the body of vertebra, causing by its pressure osteolysis. Because of this was destroyed closing plate of vertebra and began limply flowed/occurred/lasted osteomyelitis.

Besides osteomyelitis described above, with the full/total/complete anatomical interruption of spinal cord were observed heaviest osteomyelitis, which appeared out of the zone of wound canal, predominantly in the region of bedsores in rump and iliac bones. The source of these osteomyelitis was the infection of

bone from the bedsores. Roentgenologically these osteomyelitis were characterized by violently progressive osteonecrosis without any reactive changes.

In spite of established opinion, osteomyelitis should be carried to the early complications of wound.

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Osteomyelitis of spine with the bullet wounds more frequently appeared in time from 3 weeks to 2 months after wound, i.e., in the intermediate period or in the period of early complications.

Clinically osteomyelitis, depending on the purulence of infection and resistivity of organism, flowed/occurred/lasted differently. Only in the rare cases the osteomyelitic process of spine proceeded violently, sharply or subacute; almost as a rule, was observed flaccid, chronic course with the tendency toward delimitation and sequestration of the affected sectors of bone.

Frequently osteomyelitis flowed/occurred/lasted against the background the more or less considerable damage of spinal cord and severe complications from the side of the urinary tracts, bedsores, septic condition, etc.

The diagnosis of osteomyelitis was based on the account to the totality of clinical and roentgenological data. In the clinical picture by most essential ones was represented the presence of fistula with suppurative discharge, since subfebrile temperature, just as the picture of the blood, in the presence of another suppurative and tropho-paralytic complications lost its specific lines.

Bacteriologically, according to N. V. Kryzhanovskoy's data, in suppurative discharge of the osteomyelitic focus is more frequent than encountered staphylococcus (golden, suppurulent or hemolytic). On A. I. Kulovskiy's compound statistics, with osteomyelitis of spine the staphylococcus was discovered into 64.00/o of cases, streptococcus - into 12.00/o, diplococcus and coliform bacterium or the mixed infection - into 19.00/o of cases.

With emergent osteomyelitis of the body of vertebra the process usually converted/transferred also to the bodies of adjacent vertebrae. Toward the end of the intermediate period frequently it was possible to see the extensive destruction of bodies of two-three and more than vertebrae, that were being escorted/tracked by the more or less considerable compression of vertebrae.

In the given above observations osteomyelitis of one spine is noted into 20.0o/o of cases, two vertebrae - 62.8o/o and three vertebrae - into 17.2o/o of cases.

Osteomyelitis of spine was frequently escorted/tracked by the accumulation of pus according to the type of abscess with tuberculine spondylitis. Pus in this case was spread on the interfacial and the intermuscular slits, leading, depending on localization of process, to the education of the phlegmon of neck, mediastinum, small pelvis, etc. In a number of cases, as noted above, pus penetrated the spinal canal, leading in the outbreak of diffuse meningitis or to focus spinal meningitis, to external pachymeningitis and to formation of the restricted epidural abscess. Logically, in this case, besides the cerebral, grew on focus symptoms from the side of spinal cord and its rootlets, that testified about the grown on compression within the spinal canal.

I. obtained 19/I 1945 the blind-end fragmentation penetrating wound of chest with the tangent by the penetrating wound of spine at the level of the III lumbar vertebra; there was the syndrome of the contusion of rootlets of horse tail.



On DMP during perfecting of wound in the lumbar region is removed fragments of mine; on the 5th day after wound was reduced random urination. From the 8th day gradually was reduced the function of lower extremities.

9/III 1945 (on the 50th day after wound) began to grow on the paresis of right lower extremity, appeared the delay of urination.

12/III 1945 clinically was determined paralysis of rightist and deep paresis of left lower extremity with hypesthesia in the limits from the second lumbar to the fifth sacral segment; the delay of urination and defecation.

13/III 1945 appeared meningeal symptoms in the form of sharp headache, rigidity of occiput. The condition of patient became heavy. Wound in the lumbar region with abundant suppurative discharge.

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14/III 1945 with laminectomy is discovered pus in the intermuscular region, it is paravertebral. Osteomyelitis of small arcs and awned extensions of the II and IV lumbar vertebra, the depression of small arc and the break of awned extension and right cross extension of the III lumbar vertebra. In epidural space there

is much dense pus which in large quantities escape/ensued also from the overlying division of the spinal canal. solid cerebral shell is thickened, pulsation evidently. Post-operation course is smooth.

18/III appeared active movements of lower extremities, 1/X began to walk in the semirigid orthopedic corset, relying on bacillus/rod. The function of pelvic organs/controls was reduced.

On control X-ray picture 13/VI there are no indications of the osteomyelitic process.

The origination of infection in similar cases, besides the contact route/path, is explained also by its penetration on the perineural to the slits of rootlets and on the periadventitial spaces of vessels.

During the subacute and chronic course of osteomyelitis were described the following pathoanatomical changes in the contents of the spinal canal: solid cerebral shell sharply is thickened, its filaments lose normal structure, becoming homogeneous; infiltrative and fibrous stratification on it germinate connective tissue, in consequence of which either mechanically or as a result of the violation of blood of lymph circulation can develop the syndrome of the compression of spinal cord.

The treatment of osteomyelitis of spine in the Great Patriotic War evolved toward an increase in surgical activity. In 1944 A. N. Bakulev characterized the treatment of osteomyelitis of spine as follows: in the beginning of the development of osteomyelitis with the limply elapsing forms - conservative treatment, during the sharp and subacute course - operation/process.

This view shared surgeons' majority, also, to the end of the war. However, this short general/common/total characteristic does not exhaust all variants of the osteomyelitic process and insufficiently differentiates indications for surgical intervention with them. The treatment of osteomyelitis of spine depends not only on the clinical course of process (sharp/acute, chronic), but also on the localization of the damage/defeat of spine both in the longitudinal and in cross directions.

During the damage/defeat by osteomyelitis of the posterior semiring of vertebrae surgeons' majority resorted to earliest possible intervention of the type of sequestrotomy or even laminectomy, attempting to prevent the outbreak of infection in the contents of spinal canal. With osteomyelitis of the bodies of vertebrae in the lumbar division, even during the chronic course,

advisable was considered surgical intervention soon after the establishment of diagnosis.

S. obtained 14/I 1944 the tangential fragmentation, penetrating wound of spine at the level of the III-IV lumbar vertebra with the partial damage of rootlets of horse tail.

In the X-ray photograph is determined the crushed break of the left half small arc of the IV lumbar vertebra together with the lower-joint extension and the root of small arc. Fragmentation break of body of the IV lumbar vertebra with the breaking up of the left lower-joint extension of the III lumbar vertebra. In connection with the heavy condition (pneumonia) wounded operation/process proved to be impossible.

In 2 months with the repeated X-ray analysis is discovered osteomyelitis of bodies of the III, IV and V lumbar vertebra, necrosis and resorption of the bone fragments of small arc and body of the IV lumbar vertebra. Destruction captures entire body of the IV vertebra and left half body, and also the root of small arc of the V lumbar vertebra together with the left upper-joint extension, the left half body of the III lumbar vertebra and his left lower-joint extension.

13/III 1944 is produced sequestrotomy. Are removed all changed sectors of bone. Post-operation course is smooth.

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It is discharged in the satisfactory condition without the orthopedic corset. Through 4 years it is occupied by light manual labor (available lower paraparesis disappeared, the function of pelvic organs/controls was reduced after only 5 days after operation/process).

Long delay with the operation/process of sequestrotomy led to deterioration in the condition of casualty, wound cachexia, sepsis or the outbreaks of sharp/acute suppurative processes in the shells, up to generalized meningitis with the fatal result.

Special position in this respect occupied osteomyelitis of rump, which was being developed usually soon after wound. Riches with porous substance led to the rapid and deep dissemination of the osteomyelitic process in the extensive sectors of rump. Late surgical interventions in this case in the majority of the cases proved to be unsuccessful. Only with early intervention with subsequent persistent conservative treatment it was possible to rely on positive results.

I. obtained 13/V 1945 the perforating bullet wound of sacral-iliac region and the tangential penetrating wound of spine at the level of the I and II sacral vertebra with the partial damage of rootlets of horse tail at this level.

Despite the fact that already 14/V during the primary perfecting of wounds in KhPPG were removed the bone fragments, and wounds were powdered by streptocide, rapidly arose osteomyelitis of rump, began to grow on parietic phenomena and pains.

29/V (16th day after wound) apropos of expressed osteomyelitis, which took the entire lower half the left side of rump, is produced the sequestrotomy, which gave favorable result.

Exclusion presented osteomyelitis of the bodies of neck vertebrae. Sequestrotomy in the neck, especially in upper-neck, the division presents sizable danger for the life of casualty. However, experiment/experience showed that with osteomyelitis of the bodies of upper neck vertebrae the sequestrations (as a result of the special anatomical relations in this region) can withdraw outside through to a swallow, thinner/less frequent through the trachea.

T. obtained 11/VIII 1945 a mine fragment wound of the right half neck with the nonpenetrating wound of spine at the level of the III

neck vertebra. 17/X 1945 was opened/discovered lead on the posterior wall the swallows (was retropharyngeal abscess, the temperature reaching to 40°). Is superimposed gypsum collar with the fixation of head temperature it fell to the subfebrile.

3/XI 1945 through the posterior wall swallows withdrew two bone sequestrations. Temperature became normal. In 2 months gypsum collar is substituted by soft collar for 6 months. Recovery. Through 2 1/2 years it is healthy/sound. It works by agronomist. Violations from the side not no nervous system there is. Mobility of neck in the limits of norm.

Similar observations of the departure/separation of the sequestrations through to a swallow is much. The treatment of osteomyelitis of the bodies of vertebrae in the neck division in the majority of the cases remained conservative and was limited to the immobilization of neck gypsum collar or by carton or even soft collar. Sometimes suppurative flows spontaneously were revealed through anterolateral divisions of neck or on the course of wound canal in the presence of the stably held fistula. With the suspicion to the retropharyngeal delay of pus of cases of osteomyelitis of the bodies of upper three-four neck vertebrae frequently produced the sections/cuts of posterior wall the pharynxes, driving out in the appropriate cases sequestrations.

Surgeons' majority utilized lateral access to the damaged osteomyelitis to the bodies of vertebrae in the lumbar division, i.e., with the preliminary resection of the corresponding cross extensions or on the course of wound canal (fistula), during the damage/defeat of thoracic vertebrae - with the preliminary costotransversectomy.

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After sequestrotomy and solid scraping out of the affected focus in the bone to the normal boundaries its forming bed rubbed by peroxide of hydrogen and they powdered either by sulfanilamides or iodoform, or into the operational zone poured the corresponding phages.

For the treatment of osteomyelitis of spine, together with surgical intervention, in the entire hospital net/system extensively used physiotherapy, predominantly in the form of UHF therapy. So extensively was used for the purpose of general/common/total the reinforcement of organism vitaminization and fractional transfusions of blood - on 150-200 cm<sup>3</sup> which the casualties transferred very well.

Lethality with osteomyelitis of spine after bullet wounds



remained sufficiently high.

The direct cause for death with the heavy forms of osteomyelitis in third of cases was cerebrospinal meningitis, and two thirds fell to sepsis and wounded cachexia (intoxication).

On the basis of the experiment/experience of the great Patriotic War it is possible to come to the conclusion that surgeon's tactics in the relation to osteomyelitis of spine must be more active. In the majority of the cases even with the limply current forms of osteomyelitis expediently surgical intervention (sequestrotomy) in the early periods, i.e., soon on the establishment of diagnosis. Early surgical intervention is especially important with osteomyelitis of the posterior searing of vertebrae (small arc, extensions) and osteomyelitis of rump.

With osteomyelitis of the bodies of neck vertebrae, especially in the upper neck division, it is possible to rely on favorable outcome with appropriate surgical intervention and reliable immobilization of spine in combination with the physiotherapy, the antiseptics, the antibiotics and the over-all strengthening treatment. In the case of delay and with accumulation of pus it is necessary to in proper time produce sections/cuts and expansion of fistula course (in the presence of the latter) with the draining of

wound.

Sepsis.

The frequency of sepsis with the wounds of spine achieved 5.70/o for those penetrating and 1.40/o for the nonpenetrating wounds.

on the levels of the wound of spine the cases of sepsis were distributed so (Table 48):

Table 48.

(1) Уровень ранения	(2) Шейный отдел	(3) Грудной отдел	Полоснично-крестцовый (4) отдел	(5) Множественные ранения	(6) Всего
(7) Процент . .	11.5	40.1	42.0	6.4	100.0

Key: (1). Level of wound. (2). Neck division. (3). Thoracic division. (4). the lumbar-sacral division. (5). Multiple wounds. (6). In all. (7). Percentage.

The given numerals show that most frequently the sepsis was encountered with the wounds of lumbar-sacral and thoracic division of the spine.

The specific special feature/peculiarity of sepsis in those wounded the spine with the damage of spinal cord are many sources of this complication, and also frequent combination of sepsis with the wound cahexia and the intoxication from the urinary tracts and the bedsores, which burdens disease and masks the clinical picture of sepsis.

The decision/solution of a question about the primary source of sepsis in those wounded the spine presented sizable difficulties even on the autopsy.

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Frequently on the autopsy it was possible to see, together with festering of wound, osteomyelitis of spine, heavy infection of the urinary tracts, disseminated and deep bedsores, pus in the retroperitoneal space, the pleural area, etc. Each of these complications during the chronic course could be the source of the generalization of infection. Hence ensue/escape/flow out both the special features/peculiarities of course and the difficulties of the treatment of sepsis in such casualties. The questions of sepsis in those wounded the spine (besides urosepsis which he was studied by many surgeons and by urologists) were barely touched upon in those appearing after previous wars, or within the time of the Great

Patriotic War communications/reports about the bullet wounds of spine and spinal cord. On the basis of available data it is possible to come to the conclusion that sepsis in these wounded more frequently had chronic course, moreover the average life expectancy in the cases, which ended by death, was equal to 68 days (from 5 days to 11 months). Only into 5.00/o of cases of sepsis was noted turbulent flow with the rapidly advanced fatal result. In the unit of these cases in the blood was discovered pyogenic ii hemolytic streptococcus. With this group are not connected the lightning forms of anaerobic infection with the fatal result through several hours after its detection.

The periods of the onset of sepsis can be judged from data of the neuro-surgical center of the Leningrad Front, according to which the sepsis was established/installed: to 2 weeks from the day of wound - into 8.00/o of cases, from 2 weeks to 1 months - into 74.00/o, from 1 to 2 months - into 23.00/o, from 2 to 3 months - into 10.00/o, from 3 to 6 months - into 6.00/o and more than 6 months - into 2.00/o of cases.

Clinically sepsis was often expressed sufficiently distinctly. The temperature in the initial phase of sepsis carried the remitting character/nature with the oscillations/vibrations in the course of twenty-four hours in 2.5-3°, moreover were observed chills, pouring

perspirations; on the skin it was frequently visible it was visible petechial empty, itching; skin in the majority of the cases remained pale, cyanotic or acquired icteric hue. The psyche/psychics such of those wounded was either oppressed or, it is thinner/less frequent, it was possible to note euphoria with the explicit underestimation of the severity of its condition. In the terminal phase was connected profuse diarrhea, maximally draining casualty; in this case rapidly grew on cachexia, face became growing thin, with the sharpened lines. Sometimes was noted the repeated vomiting, apparently of toxic character/nature. Pulse became small, frequent. The blood initially remained typical for the suppurative complications, with leukocytosis to 14000-16000 it is above, with the preponderance of neutrophils with the considerable shift/shear of formula to the left and the reaction of settling erythrocytes to 60-70 mm an hour it is above. In the terminal phase leukocytosis disappeared as however, and other signs of the reactivity of organisms. The liver and the spleen in this case, almost as a rule, were not palpable or, remaining in the range of norm, they were morbid. Comparatively rarely (to 2.00/o of cases) at GBP was observed septicopyemia in the form of the separate suppurative foci, which were appearing in different sectors (especially in the paralyzed regions) of body. In spite of this bright clinical picture of sepsis, in the case of death of casualty on the autopsy frequently it was not possible macroscopically to reveal/detect characteristic for the sepsis pathoanatomical special

features/peculiarities. Internal organs/controls, including spleen, it was more frequently by atrophic ones, reduced in the volume. As a rule, remained reactive also lymphatic glands. In the thick intestine frequently there were signs of hemorrhagic colitis.

The treatment of sepsis was reduced to the autopsy they were suppurative flows, sequestrotomies in the cases of discovered osteomyelitis, to the draining of wound. With the suspicion of the urogenic nature of sepsis usually was laid urinofistular fistula.

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Together with the local treatment, were conducted the strengthening overall measures in the form improvements in the nourishment, introduction to fluid/liquid (abundant drinking, subcutaneous introduction of the physiological solution to 1-3 l in a 24 hour period), and also fractional blood transfusion on 100-200 cm<sup>3</sup> after 2-3 days. Some surgeons disputed the advisability of the transfusion of the blood by septic casualty. However, as showed experiment/experience, the fractional blood transfusions sometimes ejected casualty from the septic condition and they made it possible subsequently to produce radical surgery on the spine. In the second half war successfully was applied the transfusion of the conserved plasma (A. N. Bakulev).

With the sepsis extensively were used the antiseptic, in particular, sulfanilamides, through the mouth it is intravenous.

Lethality with the expressed clinical picture of sepsis remained comparatively high.

Suppurative processes in shells and spinal cord.

Associate member of the Academy of Medical Sciences of the USSR  
Honored Scientist professor I. Ya. Razdol'skiy.

One of the riskiest complications of early and intermediate period with the bullet wounds of spine were suppurative processes in the spinal cord and its shells. They included: meningomyelitis, focus spinal suppurative meningitis and diffuse spinal suppurative meningitis, suppurative pachymeningitis, epidural abscess, intra-medullary abscess.

In the first world war suppurative complications were observed fairly often. Comparatively their much were also in the beginning of the Great Patriotic War. But with an increase of the activity of the Soviet neurosurgeons, directed to the side early radical perfecting

of the wounds of spine and widespread introduction of sulfanilamides, the percentage of suppurative complications in the shells and the substance of the brain toward the end of the war sharply was lowered.

Inflammatory process covered the shells of spinal cord or for entire their elongation/extent (ascending or diffuse suppurative spinal meningitis), or only in any restricted sector (restricted spinal suppurative meningitis). The cases of diffuse meningitis quantitatively predominated. In the materials of GBF of Leningrad Front the complication of diffuse suppurative meningitis was noted in 3.50/o of all casualties, restricted - in 2.50/o.

In casualties, who were not undergoing radical perfecting and laminectomy, they were observed both diffuse and restricted suppurative meningitides. Meningitides, which complicated laminectomy, as a rule, were diffuse.

The percentage of suppurative meningitides, according to the observations of the individual authors, oscillated in the very wide limits: according to N. S. Chetverikov's data - 16.2 (1943) and 8.0 (1947), V. P. Dzbanovskiy (evacuation hospital - GBA and ORMU [separate medical reinforcement company] of North Western and 4th Ukrainian Front) - 15.2, A. S. Orlovskiy - 11.0, I. Ya. Razdol'skiy - 8.4, D. G. Goldberg - 6.3. But these data relate predominantly to the



first years of war and mainly to the penetrating wounds of spine.

General/common/total spinal suppurative meningitis (meningitis spinalis diffusa purulenta). General/common/total spinal suppurative meningitis appeared mainly in the early period.

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Restricted suppurative meningitides appeared within the later periods when have time to develop the intergrowth, which insulate the division of sub-arachnoidal space, where penetrated infection.

The periods of the onset of the diffuse form of meningitides had two distinct maximums. First of them freed with 4-5 days after wound, the second - with the end of the first two weeks. The onset of the first maximum is connected, apparently and with the recording onto the sub-arachnoidal space of especially virulent microbes by most wounding shell; the onset of the second - with the penetration of microbes into this space from the strongly infected wound canal. Within the later periods meningitides appeared mainly on the soil of suppurative foci on I neighbor with the spinal cord or the spine. Most frequently by the source of the development of meningitis in these periods were osteomyelites, bedsores, ulcers around the paravertebrally arranged/located foreign bodies.

According to author's data, the frequency of the complications of the bullet wounds of spine of suppurative meningitides rapidly grew on in the extremital direction. The development of diffuse meningitides with the wounds of the neck and thoracic division of spine was observed into 3.40/o, and with the wound of the lumbar-sacral division - into 9.70/o; restricted meningitides with the first were noted into 1.40/o of cases, with the second - into 4.60/o.

The diagnosis of diffuse suppurative spinal meningitis, as a rule, presented no difficulties, with rare exceptions, when meningitis appeared against the background of sharply pronounced wound cachexia, sepsis, peritonitis and to that of similar severe complications, which darkened the clinical picture of meningitis. The most frequent symptoms of diffuse meningitis in these casualties were the rigidity of occiput, repeated vomiting, violation of consciousness against the background of sharp/acute headaches. During the dissemination of process to the base of skull were connected paralyzes of craniocerebral nerves (III, IV, X and XII pair chiefly).

The symptoms of Kernig, Brudzinski and other in the presence the syndrome of the transverse contamination of spinal cord usually were

absent. However, during the investigation for Kernig's symptom sometimes appeared pains in the spine at the level of wound. Pressure on the front/leading wall of auditory passage proved to be in the majority of the casualties by morbid (symptom of Bekhterev). Neurologic with the onset of general/common/total suppurative meningitis frequently was observed raising the level of the fallout of sensitivity and build-up/growth of paresis.

Sometimes were observed the fibrillar twitchings of the paretic muscles of extremities. Condition of the blood as temperature curve, facilitated the establishment of diagnosis only in the absence of other suppurative complications. Diagnosis provided the investigation of cerebro-spinal fluid in which were detected the same changes as with meningitis of nonfiring origin.

Together with the sharp course of spinal meningitis, which was being rapidly generalized and which led frequently to death, were encountered the peculiar cases subacute and even chronic coursing of meningitis, characteristic, perhaps, only for those wounded the spine. Thus, on the autopsy was detected serous-suppurative meningitis in the casualties in whom with the life during the number of the weeks of observation of cortical symptoms remained very weakly expressed or even completely were absent. Sometimes was observed wavy coursing of spinal meningitis.

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So, the condition of casualty, as if getting well itself after spinal meningitis (disappearance of meningeal symptoms, changes in the cerebro-spinal fluid), after 5-7 days of bright gap/interval again it deteriorated and again was revealed/detected the syndrome of spinal meningitis. Such waves during spinal meningitis could be several. Latter/last circumstance forced doctors to abstain from the evacuation of the casualties, who transferred spinal meningitis, at least during 3-4 weeks after the liquidation of all meningeal phenomena. This wavy coursing with repeated outbreaks of meningitis with the bullet wounds of spine in a number of cases was explained the lack of elimination of the reason for festering (foreign body, bone fragment, osteomyelitis and the like).

Restricted spinal suppurative meningitis (meningitis spinalis purulenta circumscripta). Restricted spinal suppurative meningitis as the special clinical form of meningitides is for the first time isolated in the Great Patriotic War. The infection, which penetrated in any division of the sub-arachnoidal space of spinal cord, first of all was fixed/recorded in the cerebral shells of this division, producing local suppurative process. If sub-arachnoidal space was

passed for entire its elongation/extent, then infection with the sufficient virulence, swinging clear, was spread to entire sub-arachnoidal space, leading to the generalization of process and the development of general/common/total diffuse cerebrospinal meningitis.

In peacetime meningitis usually appears with the free sub-arachnoidal space and therefore in its whatever division penetrated infection, it rapidly is generalized, leading, as a rule, to the onset of general/common/total cerebrospinal meningitis.

In contrast to this during the bullet damages/defeats of spinal cord sub-arachnoidal space, up to the moment/torque of the penetration into it of microbes, at one or the other level proved to be sometimes blocked. The reason for blockade were most frequently the intergrowth between the shells, thinner/less frequent - compression of sub-arachnoidal space by foreign bodies, epidural scars, etc. If infection, after penetrating in the sub-arachnoidal space, could not overcome the obstruction, created with blockade, then its development was limited to the limits only of that division, where it penetrated, and meningitis remained local, restricted, without overgrowing into the diffuse.

The speed of the development of the intergrowth between the

shells both in the zone of the straight/direct action of the wounding shell on the spinal cord and in the distance, in the region of secondary stricken areas, depended on the series/number of conditions (character/nature of the damage of shells, liquorrhea, character/nature of infection, etc.). Data of autopsies showed that any durable intergrowth of brain or its shells rarely appeared to the 10-15th day after the bullet damage/defeat of spine. The more period it passed from the moment/torque of wound, the more relatively grew/rose a number of cases, with which appeared the intergrowth, and intergrowth themselves acquired large durability and were spread further, blocking at that or other level sub-arachnoidal space.

By the illustration of the value of the intergrowth between the shells as the factor, which limits the dissemination of infection on the sub-arachnoidal space and thus of creating conditions for the development restricted suppurative meningitis, can serve the following observation.

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I. 8/XII 1942 obtained the blind-end bullet penetrating wound of spine at the level of the XI thoracic vertebra. Inlet at the level of the XIII-IX edge/fin somewhat to the left from the spine. 2/I it entered into the Leningrad neuro-surgical institute with the syndrome

of the full/total/complete violation of the conductivity of spinal cord from the level of the first lumbar segment with the loss of reflexes on the lower extremities, the delay of urine and feces. Radicular pains no 3/I 1943 cerebrospinal puncture; the mechanical blockade of sub-arachnoidal space; cerebro-spinal fluid of canary color, soon after extraction it was rolled up. The X-ray analysis: in the area of spinal canal at the level of the I sacral vertebra was determined the bullet, turned by sharp end upwards. Subsequently were connected sharp pains in the perineum and in the floor/sex member, that were being amplified during the attempt of the patient to accept the semi-sitting position/situation (perineo-anal radicular syndrome of position/situation). 17/I Laminectomy. Bullet was discovered in the sack of solid cerebral shell at the level of the II lumbar vertebra. It is obvious, it moved here from the original position/situation or in the process of the operation/process (autopsy of spinal canal was initiated from the carving of small arcs of the V lumbar, I and II sacral vertebra), or is spontaneous in connection with the position/situation of patient on the spin. In the solid cerebral shell between the V lumbar ones and the I sacral vertebra there was a defect. Post-operation coursing initially flowed/occurred/lasted satisfactorily; subsequently advanced deterioration in the general condition, and 7/II - lethal outcome.

Data of the autopsy: bullet penetrated in the spinal canal at

height of the XI thoracic vertebra and at this level of contusion and partially crushed spinal cord. Horse tail and medullary cone in the joints which it was possible to separate only with great difficulty. Sub-arachnoidal space down from these intergrowth is filled with putriform fluid/liquid; rootlets of horse tail are covered with abundant suppurative coating. It is higher than the medullary cone - soft cerebral shells of normal mode.

In this case the infection was carried into the lumbar division of sub-arachnoidal space, apparently from the available extensive bed sore on the rump. Since up to this moment/torque at the level of medullary cone the sub-arachnoidal space was already blocked, then infection encompassed its only that division, which was located down from the place of blockade.

It was above indicated that the infection, which calls the development of restricted suppurative meningitis, most frequently penetrated the subarachnoidal space from the infected wound canal through the defect in the solid cerebral shell; somewhat less frequently it was brought in in it by shell and even more rarely it penetrated from the epidural space through the undamaged/uninjured solid cerebral shell.

The isolation of sub-arachnoidal space from the defect in the



solid cerebral shell presented most real safety method of this space from the penetration into it of the infection through the defect. Among the processes, which contributed to this insulation/isolation, great value had an occlusion of defect in the solid cerebral cortex and filling of the adjacent to it divisions of sub-arachnoidal space with edematic as a result of the trauma spinal cord. But the value of the edematic brain, which closes defect in the solid cerebral shell and which plugs sub-arachnoidal space at the level of it, was not contained by this purely mechanical activity. The caused by it pressing of soft shell against the arachnoidal contributed to their adhesion, and subsequently and to the education between them of durable intergrowth.

In contrast to this in the limits of the horse tail where is absent spinal cord, conditions for educating the intergrowth between the shells, which insulate sub-arachnoidal space from the defect in the solid cerebral shell, are less favorable. As a result this division of sub-arachnoidal space was infected approximately/exemplarily three times more frequently.

Symptom and diagnosis. In the cases, not complicated by severe cystopyelitis or septic condition, first symptoms of disease were the headache and vomiting. The blackout of consciousness usually was absent or was expressed weakly. An increase in the temperature was

observed always, but grew on temperature slower than with diffuse suppurative cerebrospinal meningitis.

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Postcranial muscle tension was noted only in the cases of high localization of meningitis, and Kernig-Brudzinskiy symptoms - only with the complication of meningitis of the partial cross damages of spinal cord. But also these symptoms were frequently unstable and subsequently usually they disappeared.

In all cases of the complete violation of the conductivity of spinal cord (anatomical interruption, full/total/complete cross crushing of spinal cord or rootlets of horse tail) the symptoms of Kernig and Brudzinski, almost as a rule, were absent.

The cerebro-spinal fluid, obtained with the puncture or on the autopsy, sometimes was pure/clean pus; the count of regular/prescribed elements/cells was frequently impossible. In all cases where was conducted cerebrospinal puncture, was detected the blockade of sub-arachnoidal space. Because of the blockade in the tightening themselves cases a quantity of protein in the cerebro-spinal fluid proved to be sharply increased, and the sometimes released fluid/liquid through several minutes was

coagulated.

The recognition of restricted spinal suppurative meningitis involved great difficulties, and with its localization in the limits of spinal cord, i.e., is higher than the II lumbar vertebra, its diagnosis could be only especially assumed, besides only in cases when the outlined reduction of conductor functions was again changed by deterioration. But in these cases it was necessary to exclude myelitis, abscess, pachymeningitis. Lumbar puncture with this localization of restricted suppurative meningitis could not contribute to its recognition. Since puncture is conducted down from the lower division of the affected by festering sector of sub-arachnoidal space, then cerebro-spinal fluid either did not completely contain neutrophils, or it contained their small quantity.

It was considerably more easily distinguish restricted suppurative meningitis with its localization in the limits of horse tail. As basis to the assumption about incipient restricted suppurative meningitis they served: the appearance of symptoms of Kernig or lower symptom of Brudzinski in the absence postcranial muscle tension, appearance or reinforcing of the radicular pains and further deterioration in the motor, sensitive, vesical or reflector functions. Of course these symptoms of restricted meningitis were absent from the cases of its development during the

full/total/complete violation of the conductivity of spinal cord.

Decisive data for the recognition of restricted suppurative meningitis in the limits of horse tail were obtained during the investigation of the spinal cord fluid/liquid, in which were detected inflammatory changes in the suppurative character/nature. differential diagnosis with general/common/total suppurative meningitis was based on the presence of the blockade of sub-arachnoidal space, the absence or the weak manifestation of general cerebral phenomena and postcranial muscle tension.

The treatment of diffuse meningitis, which arose after the bullet wound of spine, during the entire Great Patriotic War remained, as a rule, conservative.

Attempts at surgical intervention with expressed diffuse meningitis (for the purpose of the removal/distance of the source of festering in the form of foreign bodies, bone fragments, etc.) in the majority of the cases were not of use.

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M. 27/III 1944 obtained the blind-end fragmentation penetrating wound of spine at the level of the XII thoracic vertebra with the

syndrome of the partial violation of the conductivity of spinal cord at this level. 5/IV it entered into the specialized hospital GBF with the phenomena of left-side bronchopneumonia. 7/IV were increased headaches, appeared the rigidity of occiput. With the cerebrospinal puncture is obtained the turbid fluid/liquid, containing 0.60/00 protein with pleocytosis 9680/3 (predominantly polynuclear); is bacteriologically sown hemolytic streptococcus. To casualty it is assigned sulfidine, heart substances, it is intravenous glucose.

9/IV in the cerebro-spinal fluid protein 0.160/00, pleocytosis 2620 (predominantly polynuclear); 10/IV protein 0.160/00, pleocytosis 4400; 12/IV protein 1.650/00, pleocytosis 64000.

15/IV was performed laminectomy is removed the fragment of artillery shell by the size/dimension 1x1x0.5 of cm, which partially penetrated the spinal canal in the upper left joint extension of the XII thoracic vertebra.

Through the days the casualty passed away.

On the autopsy was discovered ascending diffuse suppurative meningitis. Scattered fine focal/acinous bronchopneumonia.

However, frequently it was possible to meet meningeal syndrome

with the focus accumulation of pus epidurally. In such cases could not be laid large hopes for conservative treatment with the doubtless effectiveness of active surgical treatment (emptying of pus).

K. obtained 9/XII 1944 the perforating bullet penetrating wound of spine at the level of the IV lumbar and I sacral vertebra with the syndrome of the partial damage of rootlets of horse tail and the contusion of the cone of spinal cord. More than through it is half a year in KhPPG produced laminectomy of the small arcs of the same vertebrae.

With the operation/process it is discovered considerable defect on the posterior surface of solid cerebral shell for the elongation/extent 6x2 cm, interruption of the unit of the rootlets of horse tail, blood clots between the rootlets.

13/VIII it entered into the specialized hospital of <sup>13</sup>G/P with the sharp pains in the lower extremities against the background of lower paraplegia and delay of the functions of pelvic organs/controls. Pains everyone grew on. Subsequently the wound was complicated by osteomyelitis of the wing of right iliac bone. Grew on and neurologic symptoms of pain were increased to the degree of causalgia, the zone of anesthesia rose from the fifth to the second lumbar segment.

21/X is produced the sequestrotomy of the affected divisions of right iliac bone; fistula course went to the spine. Is discovered and emptied epidural abscess at the level of the I sacral vertebra.

After this intervention sharp/acute pains disappeared. Appeared active movements in the hip and knee joints. Up to the moment/torque of evacuation it could walk with the aid of the crutches in the orthopedic foot-wear.

The conservative treatment of diffuse spinal meningitides, according to the data of the majority of the surgeons and neuropathologists, participants in the Great Patriotic War, was reduced in essence to sulfanilamide therapy. The authors more frequently put to use 6-7-day course on 6.0 sulfidines in a 24 hour period.

Sulfanilamides were introduced by sub-arachnoidally cerebrospinal puncture usually in the form 0.80/o solution of white streptocide in a quantity of 5-10 cm<sup>3</sup>. N. I. Grashchenkov in this case additionally introduced 10/o solution of sulfidine intravenously.

V. P. Dzbanovskiy (ORMU M-th front) successfully applied for the treatment of spinal meningitis the washing of sub-arachnoidal space

with 0.80/o solution of white streptocide in the physiological solution. Simultaneously was introduced one puncture needle of suboccipital into the large postcranial cistern, and the second needle - it is lumbar into the sub-arachnoidal space of lumbar division. Sub-arachnoidal space was washed downward (fluid/liquid was introduced into the large postcranial cistern and withdrew through the needle in the lumbar division). The author expended/consumed 50-100 cm<sup>3</sup> 0.80/o solution of white streptocide, in this case, according to his observations, the first portion of the withdrawn cerebro-spinal fluid in the lumbar region usually contained 4-5 times of more leukocytes, than the fluid/liquid, obtained from the large occipital cistern.

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According to V. P. Dzbanovskiy's data, the recovery of spinal meningitis attacked/advanced already after 2-3-5 washings of sub-arachnoidal space employing the procedure indicated. During this treatment of 42 casualties with spinal meningitis died only three.

Under the assumption that spinal meningitis is supported by the delay of pus in the wound, surgeons' majority took measures to an improvement in the outflow of pus and the autopsy of suppurative pockets.



In recent years of war with the great success was applied penicillin, it is considerably more than sulfanilamides, lowered percentage of lethality.

The issues of the treatment of spinal meningitis noticeably were improved with coursing of war. Thus, if in the beginning of the Great Patriotic War lethality with spinal meningitides was very high - of 49 such casualties, according to the observations of I. Ya. Razdol'skiy, perished 45 and only 4 recovered, then in the second half war (against the background of a reduction in the total number of complications of suppurative meningitis) mortality with them was lowered to 20.00/o, and in the cases of meningitis, which arose after operation/process, it is still more.

Nevertheless meningitis was a comparatively frequent reason for death: according to V. P. Dzbanovskiy's data, into 15.20/o, I. S. Babchina and by A. A. Kulikovskoy, into 16.50/o, L. I. Smirnov, into 17.90/o and Ye. A. Uspenskogo, into 15.00/o of all cases of lethal outcomes.

However, as noted above, even the subdural arranged/located abscesses and abscesses in the substance of spinal cord or among the

rootlets of horse tail can end favorably after surgical intervention.

M. obtained 4/III 1944 the blind-end fragmentation penetrating wound of spine at the level of the V lumbar vertebra with the syndrome of the partial damage of rootlets of horse tail.

10/V sharply were increased the pains in the lower extremities and the perineum. 28/IV with laminectomy is removed the metallic fragment, which was being arranged/located among the rootlets of horse tail, in this case withdrew about 1 cm<sup>3</sup> of dense pus. Sequestrotomy of osteomyelitic focus in body V lumbar vertebra. Post-operation coursing is smooth. Direct outcome - recovery.

Thus, with the diffuse form of meningitis after the bullet wound of spine the method of selection, according to the experiment/experience of the Great Patriotic War, was conservative treatment with the utilization of entire arsenal of antiseptics and antibiotics in combination with the physiotherapy. New was the washing of sub-arachnoidal space the solutions of antiseptics and antibiotics.

With the focus suppurative processes, the arranged/located subarrachnoidal or epidural, on the basis of the obtained experiment/experience it is possible to come to the conclusion about

the advisability of surgical intervention in the earliest possible periods on the establishment of diagnosis.

The external spinal suppurative pachymeningitis (peripachymeningitis). Pachymeningitis (peripachymeningitis) spinalis externa purulenta. The infection of epidural space with the penetrating bullet wounds of spine was almost rule/handspike. Sometimes suppurative pachymeningitis appeared also with the nonpenetrating wounds of spine. In these cases its sources they were: the ulcers is all around of the paravertebrally arranged/located foreign body, bedsores, festering epidural hematoma, bullet osteomyelitis of spine. In the cases of the development of suppurative pachymeningitis with the penetrating wounds of spine frequently in the suppurative accumulations or in the granulating tissue of epidural space were determined the foreign bodies.

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In the heavy cases of the tissue of epidural space they were impregnated with pus or they were pyo hemia. Changed in the majority of the cases were putridum also granulating growths. Sometimes suppurative infiltration captured the surface strata of solid cerebral shell.

Suppuration more frequently was spread in the epidural space for the elongation/extent of 4-6 adjacent vertebrae. But in a third of the cases (from a number of those checked by autopsy) it was spread almost or entire epidural space. The dissemination of suppuration on the epidural space upward, as a rule, did not exceed the limits of atlas. Evidently, the intimate cohesion of solid cerebral shell with the edges of foramen impeded the dissemination of suppuration into the epidural space of brain.

Clinically in the beginning of disease usually appeared the set of common/total symptoms of the feverish disease: a chill, malaise, increase in the temperature, headache and the like; in a

blood-leukocytosis 10000-20000 with the left-shift. Reaction of sedimenting erythrocytes increased.

Are characteristic sharp and firm radicular pains. Is typical the local spontaneous pain in the spine, which is amplified with the percussion of awl extensions. Are frequent the tonicary symptoms. With the localization in the neck and upper-thoracic division of spine was noted the stress/voltage of postcranial muscles and the upper symptom of Brudzinski; with the localization in the lumbar and lower-thoracic division, in the conductivity of spinal cord or rootlets of horse tail was preserved, symptom of Kernig and lower symptom of Brudzinski. Fairly often was observed the sickliness in the region of localization of pachymeningitis, which appeared with bending of head to the chest.

Are frequent the tonic muscle tensions of the back: they were sharper they were expressed during the relatively moderate/mild damages/infarcts of brain. Sometimes appeared tonic stresses/voltages in the separate muscular groups or extremities. Are frequent edemas of the soft tissues of back in the region of localization of pachymeningitis.

If the vessels of epidural space or the sack of solid cerebral shell underwent considerable compression, to the radicular pains were

connected segmental and conductor spinal violations and was disturbed/detuned the function of pelvic organs/controls. In the heavy cases were developed full/total/complete paraplegia, delay of urine and chair/stool. Tendonous reflexes in the sharp/acute stage of disease usually first risen or disappeared. Muscular tone in the paralyzed muscles fell. Subsequently, if patient did not perish, flaccid paralysis converted/transferred into the spastic.

Changes in the cerebro-spinal fluid are not characteristic. Usually was detected the moderate increase in pressure and content of protein. Cytosis oscillated in the limits of 2-3 tens in 1 mm<sup>3</sup> with the predominance of lymphocytes. During the strong compression of solid cerebral shell by suppurative accumulations or by organized scars appeared the blockade of sub-arachnoidal space with typical for it changes in the cerebro-spinal fluid. Sometimes could be obtained pus with the puncture of epidural space. The diagnosis of pachymeningitis in similar cases did not remain in doubts.

With the complications of pachymeningitis of restricted or general/common/total suppurative meningitis in the cerebro-spinal fluid were detected the corresponding changes.

As an example of the described development of the clinical picture of the pachymeningitis, which complicates the bullet damages of spinal cord, serves the following observation.

II. It is wounded by the bullet 24/XII of 1942. Outlet in a posterior-external division of the left half neck, at the level of the axonal extension of the III neck vertebra. Bullet moved out through the mouth and caused the break of the right half lower mandible. 25/XII it entered into the specialized evacuation hospital GBA. Immediately after wound paralysis of left hand and short-time weakness of right hand. Clinically and radiographically the damage of spine it is not discovered. Neurologic (7.1 1943) the spastic paresis of left hand, the mildly expressed symptom of Babinski to the left and to the left Claude Bernard-Gore's syndrome. Toward the end of January parietic phenomena in the left hand almost completely disappeared, but came to light the phlegmon of deep divisions of left neck region. 30/I apropos of phlegmon is produced the expansion of the course of wound canal from the side of occiput; from the expanded wound was secreted pus in a considerable quantity. 2/II appeared sharp pains in the neck region and then the rapidly grown on weakness into all four extremities; to 6/II developed flaccid paralysis of upper extremities and deep spastic paresis of lower extremities, delay of urine; the sharp postcranial muscle tension.

The diagnosis of suppurative pachymeningitis did not produce doubt, but, in view of the heavy condition of wounded, surgical intervention was restricted to a deep section/cut on the posterior edge of large sternocleidomastoid muscle, through which was secreted a large quantity of pus from deep divisions of neck. 9/II lethal outcome with the phenomena of paralysis of respiration.

Data of the autopsy: the punction of wound canal and deep tissues of neck. Suppurative peripachymeningitis the neck division of spinal cord; edema of the neck division of the spinal cord and the medulla oblongata.

In the given case spinal phenomena up to the moment/torque of the development of pachymeningitis almost were absent. They arose in connection with the suppurative pachymeningitis.

But the cases of this typical development of suppurative pachymeningitis during the bullet damages of spinal cord were observed not frequently. Usually pachymeningitis appeared against the background of the heavy damage of spinal cord, frequently with the clinical picture of the full/total/complete violation of its conductivity. The latter fact laid on the picture of disease a deep impression.



The general/common/total symptoms of feverish disease usually remained the same as with the usual form of pachymeningitis. But the build-up/growth of conductor violations was absent. Radicular pains were absent or they were weakly expressed. They came forward in the distinct form only during the dissemination of process in the proximal direction and with the implication in the suffering of rootlets of spinal cord, arranged/located higher than place of its damage. Since tendonous reflexes were usually already lost in connection with the damage of spinal cord, then pachymeningitis introduced nothing new into their condition.

Postcranial muscle tension was observed frequently. But the symptom of Kernig, the upper and lower symptom of Brudzinski, in view of the suppression of the reflector function of spinal cord down from the damage, usually were absent. They were observed only during the partial violation of the conductivity of spinal cord.

Coursing of suppurative pachymeningitis, complicating the bullet damages of spinal cord, was both the sharp/acute and subacute. Sharp coursing was observed, if disease was developed within the next few days after wound. Evidently, it is connected with the primary infection of epidural space. Subacute coursing was observed mainly during the development of pachymeningitis on the soil of festering epidural hematoma or in connection with the penetration into the

epidural space of infection from the ulcers is all around of the paravertebrally arranged/located foreign bodies, from osteomyelitic foci, the bedsores.

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Can advance the reverse development of the suppurative pachymeningitis, which complicated the bullet damage of spinal cord? Possibility this it is not possible to count excluded. It is very probable that these cicatricial changes in the tissues of epidural space and considerable thickenings of solid cerebral shell, sometimes to 6-10 mm which it was necessary to observe with late laminectomies, in the unit of the cases were the residual phenomena of the suppurative pachymeningitis, which was subjected to reverse development.

The recognition of sharp/acute suppurative bullet pachymeningitis presented great difficulties. Of 23 cases, which were being observed personally by the author, they were correctly identified only by 9.

The important sign of pachymeningitis was the sickliness of aimed extensions in the zone of pachymeningitis at a pressure on them and with the percussion. But to utilize this symptom for the

recognition of pachymeningitis during the bullet damages of brain it was usually impossible, since the sickliness of vertebrae at a pressure and a percussion first of all was connected with the trauma, plotted/applied to them with the wounding shell. Only in cases when this sickliness was observed in the vertebrae, those more or less removed is cranial from the vertebra, damaged by the wounding shell, it could be estimated as the symptom of pachymeningitis.

The aforesaid in the identical measure related also to local edema. With the localization of the fostered wound near the spine with difficulty it was to solve, was connected edema with the wound or it serves as the manifestation of suppuration in the epidural space.

The build-up/growth of the symptoms of the cross compression of spinal cord, and its equal and particular pains it could be used for the diagnosis of pachymeningitis only when the damage, plotted/applied to spinal cord, was insignificant. But such cases were exclusion. However, in the cases of a deep damage of spinal cord, if pachymeningitis was not spread above focus, it introduced nothing new into the already available objective clinical picture, and its presence, the greater, it was possible to only to hypothesize.

As basis for the assumption about the developing pachymeningitis they usually served: the prolonged festering of the wound, which penetrates into the spinal canal, the development of the ulcers is all around of the paravertebrally arranged/located foreign bodies, osteomyelitis of vertebrae, presence in the spinal canal of bullets or metallic fragments. The possibility of the development of purulent pachymeningitis could be allowed also for the duration of the existence of extensive褥疮s on the rump.

With the suspicion to the presence of pachymeningitis of the lumbar division of epidural space the neurosurgeons resorted to the puncture of this region, trying to exhaust pus with the aid of the syringe.

The basic diseases with which it was necessary to differentiate suppurative pachymeningitis, they were: restricted and diffuse suppurative meningitis, suppurative meningomyelitis, osteomyelitis of vertebrae, abscesses of spinal cord. Suppurative pachymeningitis most frequently appeared with the penetrating wounds of spine. Therefore with each wound of this genus, especially if the healing of wound after the produced operation/process flowed/occurred/lasted with the considerable festering, the completely appropriately preventive designation/purpose of antiseptics or antibiotics. With the suspicion on the developing pachymeningitis must be applied their massive

doses. Some neurosurgeons introduced antibiotics epidurally.

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The developed technique of epidural injections allowed/assumed their introduction to any division of epidural space.

The best measure or prophylaxis of suppurative pachymeningitis was the removal/distance of the wounding shells and bone fragments from the spinal canal. Experiment/experience showed also the advisability of removal/distance and paravertebrally arranged/located the more or less large/coarse wounding shells, and it is also earlier and the most radical possible treatment of osteomyelitis of vertebrae.

With the restricted forms of pachymeningitis is shown surgical treatment.

Suppurative meningomyelitis (meningomyelitis purulenta).  
Suppurative meningomyelitis in the period of the Great Patriotic War it was considered one of the rare complications of the bullet wounds of spinal cord. But in the literature, which relates to the first world war, about it in no way it is mentioned. The author in the Great Patriotic War observed suppurative meningomyelitis altogether

only into 1.30/3 of bullet wounds of spine and spinal cord, checked on the autopsy or on the operation/process. According to his data in the war with the White Finns these complications were encountered somewhat more frequent.

Based on materials of the protocols of autopsies, diffuse meningomyelitis it was the reason for lethal outcomes in the same percentage of the cases (L. I. Saimov). It is possible that the cicatricial changes in the spinal cord, detected on the autopsies in the later periods, in the unit or the cases were the issues of suppurative meningomyelitis.

Suppurative meningomyelitis more frequently appeared in combination with other suppurative complications. The violation of the integrity of spinal canal and especially dura mater, apparently contributed to the development of meningomyelitis.

In the single cases of the development of suppurative myelitis with the undamaged/uninjured solid cerebral shell the infection penetrated the spinal cord, apparently metastatical, in particular, for example, from the bed sore.

Myelitic focus sometimes underwent the suppurative melting, which converted/transferred without the distinct boundaries into the

surrounding tissue. These cases usually were considered as the initial stage of abscess.

The recognition of suppurative meningomyelites, which complicated the bullet damages of spinal cord with the full/total/complete cross syndrome is in practice unrealizable; is the larger, it can be as especially assumed. Basis to the assumed diagnosis is served prolonged liquorrhea and presence of foreign bodies in the area of spinal canal.

Considerably greater authenticity acquired the diagnosis of myelitis during the rapid build-up/growth of deterioration in the cases of the partial violation of the conductivity of brain and appearance or reinforcing of radicular pains.

The differential diagnosis of suppurative meningomyelitis with the intra-medullary, the subdural and the epidural abscesses with the contemporary knowledge about the clinic of the latter hardly is possible. In favor of epidural abscess and against meningomyelitis with known in fraction/portion probability he speaks development or build-up of the already available partial cross syndrome in the wounded, suffered osteomyelitis vertebra.

Abscesses. Abscesses were epidural, subdural and

intra-medullary. They were among rare purulent complications. According to the data of the development of the histories of illnesses, the abscesses occurred into 0.30/o.

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Epidural abscess. Together with the diffuse suppurative pachymeningitis, in the epidural space both on the course of wound canal and in its surrounding tissues were encountered restricted and to a certain degree encysted accumulations of pus. In the area of these ulcers usually were arranged/located metallic foreign bodies or bone fragments. Conditionally these suppurative accumulations were considered as epidural abscesses.

Epidural abscesses in the Great Patriotic War observed many neuropathologists and neurosurgeons. For the epidural abscesses in contrast to the diffuse suppurative pachymeningitis is characteristic the absence of clinical indications of the dissemination of process in the vertical direction.

If the epidural abscess developed the casualty has with the full/total/complete violation of the conductivity of spinal cord, besides in that running a fever in connection with any complication, then it flowed/occurred/lasted concealed/latent and it was detected



either on the autopsy or on the operating table. However, in the cases of the partial violation of the conductivity of brain the increase of the gross damage/destruction of spinal cord was usually developed sharply, during 2-3 days.

N. obtained the blind-end fragmentation wound of the thoracic division of spine. At the moment of wound it underwent the perception of numbness, the small weakness of lower extremities and the shooting pains in the region perineal. Independently passed about 5 km to the point/post of first aid, 29/VI it entered into the general-surgical evacuation hospital. Being located in the hospital, it walked freely.

3/IX after sharp movement in the bed it noted small difficulty during the urination, subsequently it rapid that grown on.

3/IX appeared encircling pains around the lower divisions of stomach, a chill; temperature was increased, and during the same day advanced paralysis of lower extremities and full/total/complete delay of urine. With the X-ray analysis of spine is discovered the large/course (1x1.5 cm) metallic fragment, which was being arranged/located "deeply in the soft tissues of back at the level of the XI thoracic vertebra, in its averted extension. Possibly there was a damage of averted extension which in the X-ray photographs is expressed unclearly". Neuropathologist 3/IX noted lower paraplegia,

increase in tendinous-periosteal reflexes, clonus of feet, anesthesia of the eleventh thoracic segment, absence of pathological foot reflexes. 9/IX under the local anesthesia is removed bone fragment; metallic fragment was not extracted. Into the same day it is converted into the Leningrad neuro-surgical institute. Neurologic status from 10/IX: the stress/voltage of back muscles, the diffuse sickliness of spine with the percussion, flaccid lower paraplegia with the areflexion; the loss of skin sensitivity to the right from the second lumbar, to the left - from the first lumbar segment, and musculoarticular - in the interphalangeal and talocrural joints. The compression of the fold of skin in the region of shin and fingers/pins perceives. Delay of urine and chair/stool.

In view of the sharp/acute development of constrictor spinal phenomena against the background of the emergent feverish condition, the muscle tension of back, sickliness of spine with the percussion and changes in the white blood (leukocytosis with the left-shift and increased reaction of settling erythrocytes) pathological process was identified as acute external pachymeningitis. Since conservative treatment did not give effect, 17/IX it was produced laminectomy. In the basis of the awned extension of the XI thoracic vertebra was discovered metallic fragment by the size/dimension 2x1.5 cm. Fragment was arranged/located in the area, filled with dense greenish pus. With cutting of the basis of the awned extension of the XI

thoracic vertebra from the area of spinal canal came forward the drop of dense green pus. After the removal/distance of small arcs of the X-XI-XII vertebra it is discovered, that the epidural space at the level of the XI thoracic vertebra is filled with granulations and pus the zone of dissemination of which is distinctly delimited from the surrounding tissues. The been absent within the limits of operating field pulsation of dural sack appeared after the removal/distance of granulations.

Post-operation coursing was smooth; however, for long was held deep spastic paraparesis.

It is doubtless, functional success would be still better, whereas if operation/process was produced during the first days after the development of abscess, i.e., before it had time to cause in the spinal cord considerable changes.

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Epidural abscess-very favorable object for the surgical treatment, which was escorted/tracked by the careful perfecting (antiseptic, sulfanilamides, antibiotics) of the place of abscess and adjacent to it tissues.

Intra-medullary abscesses. The bullet wounds of spine rarely were complicated by intra-medullary abscess; Ye. P. Vlasov to 377 wounds of spine it saw 4 intra-medullary abscesses.

Of 4 cases, which were being observed personally by the author to 600 wounds of spine, into two abscess it arose around the mine fragments, in one - all around bone, in the fourth case in the area of abscess the foreign body was not discovered, but in the solid cerebral shell there was a defect. In the cases, described of E. P. Vlasovoy, cerebral shell was not solid damaged; Ye. I. Sirotinoy's in the case the abscess developed around the bullet, while Ya. M. Krinitskiy's in the case - on the soil of osteomyelitis.

Intra-medullary abscesses belong, apparently to the group of early suppurative complications. In author's all 4 cases they developed within the limits of the first 2-3 weeks after wound.

If intra-medullary abscess appeared when the partial violation of the conductivity of spinal cord is present, then its development was characterized by the rapid, during 1-2 days, build-up/growth of the syndrome of the full/total/complete violation of the conductivity of spinal cord. But if abscess was developed when the syndrome of the full/total/complete violation of conductivity is present, then in the sense of the new fallout of functions it became apparent in no way;

therefore the diagnosis of abscess was placed only in first-order cases, but sides only supposedly, since according to the same type is developed acute myelitis.

The intravital diagnosis of bullet intra-medullary abscesses is extremely difficult and could be only assumed. In doubtful cases diagnosis could ensure exploratory laminectomy with the exposure of spinal cord or its puncture through the solid cerebral shell. From 4 cases of intra-medullary abscess, published E. F. Vlasovaya in 3 cases it was conducted laminectomy, but in two of them abscesses were not discovered, since solid cerebral shell they did not reveal. In the fourth case solid cerebral shell was opened, abscess was discovered and removed; this case ended by the fatal result from suppurative meningitis.

The surgical treatment of intra-medullary abscesses is not hopeless. Of 36 cases, published in the literature, 3 cases were cured operationally. Recovery was achieved also in cases published by E. I. Sirotnoy, Ya. M. Krinitsky and P. I. Slivoy.

Nevertheless basic struggle with this serious complication of the bullet wounds/infarcts of spinal cord must be conducted according to the line of their prophylaxis, in particular, it must consist of the earliest possible removal/extraction of foreign bodies of the

spinal cord and the occlusion or defect of the solid cerebral shell.  
The candidate of medical sciences Docent D. G. Goldberg.

Contractures. <sup>4</sup> Frequent complication with bullet wounds of spine and spinal cord or horse tail were the contractures of extremities.

The contractures of the joints of extremities appeared in essence as the consequence: a) paralyzes of separate muscles (flaccid or spastic character/nature); b) changes in joints, c) the pains, which achieved considerable degree, d) the faulty stacking of casualty.

Page 317. <sup>4</sup> It is virtually important that the long existing "active" contracture gives birth to in the tissues deep nutritive changes, stable functional shortening of muscles. This active contracture in the course of time converts/transfers into the passive, with difficulty yielding to correction. The investigations of A. G. Ginetzinskiy, produced during the Great Patriotic War, confirmed the given above special feature/peculiarity of the development of the majority of the contractures of bullet origin. Pathoanatomical investigations showed that at the basis of the changes, which occur in the tissues with the contractures, it lies/rests the local violation of metabolism and trophic disorders.

a) contractures as a result of paralyzes of separate muscles by the mechanism resemble the known contractures, which escort/track the damages of peripheral nerve trunks. Thus, with the fallout (and atrophy) of some muscles take preponderance the preserved tone antagonists, aiding extremity unusual and peculiar position/situation. It is not possible to eliminate in this case and the reflector effects from the stricken area of spinal cord or its rootlets.

In the Great Patriotic War it was possible to observe the onset of such contractures, now and then very whimsical character/nature, with wounding of the neck division of spine and spinal cord, especially with the paravertebral and nonpenetrating wounds, and also during the closed damages of spine, which were being escorted/tracked by hemorrhage into the substance of spinal cord and corresponding segmental violations. To this usually were connected radicular damages, so/such characteristic for the bullet wounds of the neck division of spine. Hands frequently accepted in this case peculiar pose with the hyperextension of fingers/pins in the metacarpophalangeal and interphalangeal joints, against the background of the atrophy of the separate groups of muscles. Is analogous the mechanism of the contractures of lower extremities during the described damages with the hemorrhage into the substance of spinal cord at the level of lumbar thickening (which was

encountered more rarely) and especially during the damage/defeat of separate rootlets of horse tail.

The enumerated forms/species of contractures can be considered as the contractures, connected with flaccid paralysis of separate muscles.

b) at the end of the intermediate and mainly in the late period after wound appeared contractures connected with spastic paralysis of more frequent than lower extremities. Such contractures, very painful for the patient and which difficultly was inferior to different therapeutic measures, were the product of the involuntary spontaneous contractions/abbreviations of one or the other group of the muscles of extremities or appeared according to the type of shielding reflexes against the background or an increase in the tone of muscles.

The spastic contractures of lower extremities were encountered predominantly the bending type (extremities were bent in the hip and knee joints, usually with the back inflexion of foot and fingers/pins), and also the extensor or mixed type (extremities were driven away in the hip and knee joint with the bottom or back inflexion of foot and fingers/pins).



were observed other combined forms of spastic contractures (Fig. 115 and 116).

Almost as a rule, thighs in this case they were in the state of extreme reduction and even crossing in extra-heavy cases.

Spastic contractures were observed, as a rule, during the damage/defeat of spinal cord it is higher than the lumbar thickening.

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Sometimes already in the beginning of intermediate period coursing of wound was complicated by different intra-articular changes. In essence intra-articular changes were secondary as a result of the fact that the extremity for long was located in the faulty position/situation. However, it was not possible to exclude the roles of the violation of trophic system, which led to the multifeature degenerate changes in the tissues of joints.

c) By frequently contracture of extremities was the consequence of considerable pains, especially with the wound of rootlets of horse tail. Extremities in this case accepted the pose of shortening in the form of flexure in the knee, hip, or talocrural joints in different combinations. Upper extremity with the contracture acquired the

corresponding position/situation of the reduction of shoulder with the flexure in the cubital, and sometimes also in the radiocarpal joint; fingers/pins in this case proved to be in the pose of obstetrician's hand or they were bent in the interphalangeal joints and tightly forced against palm. Attempts in this case to passively drive away extremity were extremely morbid and ineffective (without the elimination of the source of pains).

d) ~~It~~ **Is** doubtless, in the onset of contractures with the bullet wounds of spine with the damage of spinal cord, its rootlets and shells played known role the faulty stacking of casualty and insufficiently attentive care of it. With the more or less massive trauma of spinal cord or rootlets of horse tail active movements frequently were reduced (if they were reduced generally) in time when has already been formed/activated contracture in connection with changes indicated above in the joints and the muscles. For paralyzed muscles, especially the muscles of foot and fingers/pins, even blanket presented such severity, which led to the flexure of foot and fingers/pins.

From that given above escape/ensued the corresponding preventive and therapeutic measures. Casualty one ought not to have correctly put moreover knee joints they must be in the position/situation of light flexure (160-170°), and the foot - at right angle,

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fixed/recorded by longer bandages or wire splints, moreover in the region of the ankles/malleoli and under the heels they laid the sufficient layer of cotton.



Fig. 115. Spastic contracture of the lower extremities of the afterward tangential bullet penetrating wound at the level of the VIII thoracic vertebra.

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Experiment/experience showed that for this purpose the support/socket of boxes, panels, stools and other attachments was unsuitable, since they did not hold foot in the correct position.

For the purpose of prophylaxis of contractures in the hospitals systematically were conducted passive, and in proportion to the reduction of the function of spinal cord and active exercises for muscles and joints of the affected divisions of extremities. Under the favorable conditions this therapeutic gymnastics in the hospitals is begun from the second week after wound. Therapeutic gymnastics in

the majority of the hospitals or front line area was supplemented by the massage of the paralyzed muscles.

To extremely important ones was represented the earliest possible elimination of the source of pains by available substances. As showed experiment/experience, most radical measure in this respect was early laminectomy with corresponding meningomyeloradicotomy. Sometimes elimination or softening of pains helped the blockade of the corresponding rootlets by novocaine, the various forms of physiotherapy (UVCh, bromnovocaine, ionophoresis, etc.) and pharmacotherapy.

Considerable difficulties stood before the doctor in attendance with the already emergent contracture.

The contractures of lower extremities as a result of flaccid paralysis, as showed experiment/experience, sufficiently effective proved to be surgical interventions of orthopedic character/nature on the tendons and the joints in combination with redressment of the involved in the suffering joints and with the subsequent supply of patient with the appropriate orthopedic apparatuses and with the foot-wear (see below).

Considerably great difficulties presented the treatment of the

contractures of extremities, connected with their spastic paralysis in the cases of the heavy damage of spinal cord in its thoracic or neck division.

One should recognize that also toward the end of the Great Patriotic War the surgeons of our country and foreign, did not arrive at the unanimous acknowledgement of the advantages of any of the conservative or surgical methods of the treatment of the contractures of spastic origin.



Fig. 116. Spastic bending contracture of lower extremities.

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For the treatment of such contractures they resorted to different operations/processes: the cutting of posterior rootlets, the cutting of the muscular branches of peripheral nerves on Shtoffel', A. L. Polanova, different interventions on the frontier sympathetic shift, his ganglia/nodes and connective branches; disconnection and elongation of tendons. Furthermore, were applied different forms/species of physiotherapy, aserine and its derivatives (V. G. Lazarev et al.), acetylcholine (S. N. Davidenkov), etc., but all enumerated measures proved to be insufficient for the treatment of the heavy forms of spastic paralysis and contractures. Is hence

understandable surgeons' tendency toward the complex use/application of different surgical interventions in combination with the physiotherapy, the medicinal treatment, the conservative orthopedic measures, in particular, by the supply with different orthopedic apparatuses. Some surgeons even established/installed, in what sequence should be taken different therapeutic measures.

As illustration can serve the following observation of I. M. Grigorovskiy (Neurokhirurgiches the institute of the Academy of medical sciences of the USSR).

S. obtained 15/I 1943 perforating bullet wound in upper-thoracic division of spine. In the hospital basis of Moscow neuro-surgical institute is entered 13/III 1944 with the sharply fixed/recorded bending contractures in the hip and knee joints, with stable reduction of both thighs, with the state of preservation of movements in the talocrural joints. In the X-ray photographs is revealed/detected the sector, suspicious to the damage of small arcs and awned extensions of the IV and V thoracic vertebra. In the cerebro-spinal fluid of changes it is not discovered. With the liquorodynamic tests/samples the block/module/unit is not established/installed.

In the preceding/previous stages apropos of contractures they



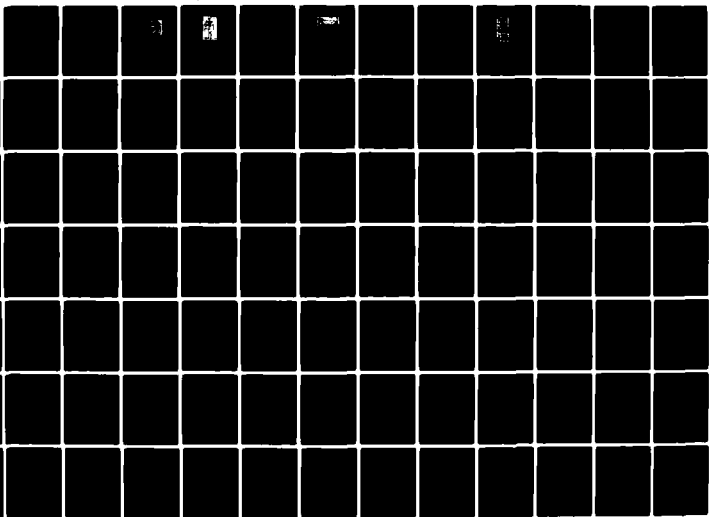
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FOREIGN TECHNOLOGY DIV WRIGHT-PATTERSON AFB OH F/G 6/5  
EXPERIENCE OF SOVIET MEDICINE IN A GREAT PATRIOTIC WAR 1941-194--ETC(U)  
AUG 80 D G GOLDBERG, I Y RAZDOL'SKIY  
FTD-ID(RS)T-0791-80

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resorted to redressment and imposition of gypsum, but gypsum it was necessary to remove/take as a result of the development of bedsores. Again advanced the reduction of lower extremities and contracture.

To patient was produced the series of the operations/processes as a result of which it could heave, and then walk. That produced 23/III 1944 laminectomy of the III and IV thoracic vertebra with the autopsy of solid cerebral shell showed presence Rbvtsov on the solid cerebral shell, joint of the latter with the soft cerebral shell and the rootlets. After removal/distance Rbvtsov and dissociation of intralural joints appeared the pulsation of spinal cord.

Following this operation/process, which did not give effect, to patient it was consecutively/serially produced the 4 additional operations/processes: 20/IV 1944 bilateral sympathectomy of the second and third lumbar ganglion/node, whereas after which during the next days considerably was lowered the muscular tone of lower extremities and the possibility of independent movements. 12/V operation/process on the tendons of flexors in lower third of left thigh (undercutting and elongation). 31/V the operation/process of Shtoffel' on the closing nerves and 26/VII operation/process on the tendons of flexors in lower third of right thigh (undercutting and elongation).

During entire time and subsequently was applied the

physiotherapy, massage and therapeutic exercise.

During September 1944 casualty began to walk with the aid of the crutches, and then with the stick. From October 1944 through April 1945 it put to use physiotherapy in the institute of health resort science. During July 1945 it is demonstrated in the Moscow surgical society - walks well, putting to use only stick.

The given observation testifies, on one hand, about the difficulties of the treatment of spastic contractures, and from other - about advisability of the persistently conducted complex measures of surgical, orthopedic and physical therapy character/nature, including therapeutic gymnastics.

In the more mild cases it proved to be effective and radicotomy of posterior rootlets in combination with meningoysis (Fig. 117 and 118) or even the systematically conducted stretching for the shins (Fig. 119).

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Fig. 117. Spastic contracture of lower extremities of afterward blind-end fragmentation penetrating wound at the level of IV thoracic vertebra.



Fig. 118. The same patient, that in Fig. 117, after cutting of rear rootlets (II-IV lumbar from both sides).

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However, as showed the experiment/experience of surgeons' majority, in the cases of the massive and long existing spastic contractures taking separate measures proved to be insufficiently, as they were insufficient both balneotherapy and use/application of pharmacological substances, which gave only temporary/time effect.

At the same time one should consider that, producing early surgical intervention on the spine, on the contents of spinal canal with the available release of spinal cord, shells and rootlets from the compression, it was possible frequently to prevent or to soften clinic of contractures subsequently.

One should emphasize that spinal automatisms and spastic contractures, which appeared usually at the end of the intermediate and beginning of late period after wound, in any way could not be considered as contraindication to late laminectomy with appropriate meningeo-cyelo-radikolysis. On the contrary, laminectomy (even repeated) in similar cases it was considered the first stage of the treatment of spastic contracture and as the measure, directed toward the elimination of the source of stimulation in the spinal cord and its rootlets (S. I. Zivilyuk).

Sequence of operations, produced following the laminectomy, must be found in the dependence both on its results and on the specific picture on the periphery, i.e., from the degree of contractures.

In the circuit of surgical interventions during the treatment of spastic contractures and spinal automatism (laminectomy, sympathectomy, operation/process on the nerve shafts and their muscular branches, orthopedic interventions) the high value had the permanent systematic use/application of balneo- and physiotherapy, massage and special therapeutic gymnastics.



Fig. 119. Stretching for the snins by lady's mantles with the spastic contracture.

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The prolonged existence of spastic contractures led to the stable secondary changes in the joints, the muscles and the tendons which required already more complex orthopedic interventions on joints and bones of the type arthroplasty, osteotomies in combination with the operations/processes on the tendons and the muscles.

K. Raneniyev spinal cord at the level of the XI thoracic vertebra. From the moment/torque of wound in the course of 4 months was full/total/complete paralysis of both lower extremities and delay

of urine. It was made operation sectio alta. In 2 months the urination was reduced. In 6 months were reduced the movements of left lower extremity and the insignificant movements of the fingers/pins of right lower extremity.

With the inspection: the active movements of upper extremities and left lower are unconfined; the movements of right lower extremity are absent; with exception of the insignificant movements of fingers/pins. Tone in the muscles of the right strut is sharply increased, by left - it is not changed. Sharp spastic phenomena in the right strut. With the right strut it can produce only passive movements in the limits of bending contractures in the hip and knee joint.

With laminectomy of the X, XI and XII thoracic and I lumbar vertebra discovered the hernial diverticulum of the thinned cicatricial sector of solid cerebral shell; the pulsation of brain hardly it is noticeable. During the revision of spinal cord at the level of the XI and XII thoracic vertebra are discovered loose arachnoidal joints with the partial damage of spinal cord. Rootlets by dense scar are soldered with the cerebral shell. Was produced myelodivulsiolysis, and subsequently tenotomy and myotomy m semitendinosus. The condition of patient considerably was improved. Contractures are almost completely eliminated. Patient began to be



moved, putting to use the orthopedic apparatus (Fig. 120).

Late complications.

Candidate of Medical sciences docent D. G. Gol'dsrg.

Bone changes in the spine. Late complications after the wound of spine and spinal cord became apparent mainly in the form of bone changes in the spine and changes in the shells (arachnoiditis, chronic cicatricial pachymeningitis).

Bone changes in the spine as compression breaks with the compression of spinal cord with the bullet wounds, were encountered rarely and they were observed only during the heavy damages of the bodies of two-three adjacent vertebrae.

For osteomyelitis of the bodies of vertebrae is characteristic settling the body of the damaged vertebra with the education of cyphotic bending at the level of focus and possible compression of the contained spinal canal. In the late period after the bullet wound of spine frequently were encountered changes in the type of deforming spondylarthrosis which sometimes led to the violation of statics and mobility of spine. But these bone changes with the bullet wounds were encountered nevertheless more thinly/less frequently than with the closed breaks of spine. The education of excess corn in the region of break sometimes led to the compression of spinal cord.



Fig. 120. Fixation apparatuses for paralytic lower extremities.

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Excess callus frequently was observed with the operations/processes in the intermediate and late period, moreover sometimes this corn could be seen after only 3-4 weeks after wound. With the repeated operations/processes in 6-8 months and later after wound it was necessary to be encountered not only with the scar tissue of chondral density, but also with the distinct bone-

incrustations in the scar, which clearly squeezed spinal cord or horse tail. This can be illustrated by the following observation.

P. obtained 16/VII 1944 perforating bullet wound of back with the tangential penetrating wound on spine at the level of the X-XI thoracic vertebra (break of awned extensions and small arcs of these vertebrae). In 10 months in patient are noted the spastic paraplegia of lower extremities, the anesthesia of all forms/species of sensitivity from the eighth thoracic segment down, the pain in the region of stomach and lower extremities. Delay of chair/stool. Urine is deviated through bladder fistula.

With the operation/process 29/V of 1945 is discovered the following: awned extension X of thoracic vertebra is mobile/motile, and small arcs of the X and XI thoracic vertebra are damaged, soldered into the general/common/total large/coarse amorphous corn with Rubtsov by the conglomerate or soft tissues. After removal/distance Rubtsov and callus appeared the pulsation of dural sack. The blockade of sub-arachnoidal space disappeared. After 5 days disappeared the pains in the region of stomach. Gradually appeared active movements in the lower extremities.

Spinal arachnoiditis (restricted spinal serous meningitis (arachnoiditis spinalis. Leptomeningitis spinalis serosa

circumscribed) ].

Corresponding Member of the Academy of Medical Sciences of the USSR honored worker of science professor I. R. Razdol'skiy.

Arachnoiditis - the very frequent from the late complications of the bullet wounds of spine and spinal cord. K. P. Chikovani in the rear hospitals observed arachnoiditis into 32.20/o of cases of the bullet wounds of spinal cord. Analogous numerals are published by other authors. Arachnoiditis especially frequently was encountered with laminectomies, produced in the intermediate and late period, and also in those been killed in these periods. Thus, for instance, I. Ya. Razdol'skiy noted the presence of arachnoiditis after 6 and more than weeks after wound in 70.40/o all operated or killed of those wounded the spine.

Pathomorphologically arachnoiditis became apparent in two basic forms: by cystic (arachnoiditis spinalis cystica) and by adhesive (adhaesiva); predominated adhesive form, but were frequent combinations of both forms. In the region of the basic focus of damage usually appeared adhesive arachnoiditis, and in the neighborhood and into a distance-the cystic. Especially powerful/thick adhesive arachnoidites were observed in the region of horse tail. Outgrowing and soldering rootlets of horse tail, the

inflammatory growths of soft shells frequently converted it into the similarity of dense cord/mass.

In the vertical direction arachnoidites in separate casualties captured very extensive regions, stretching to 6-8 and more than segments (arachnoiditis spinalis diffusa). Thus, sometimes during the damages/diseases of horse tail they stretched to upper-neck division of spinal cord inclusively.

The unfavorable effect of arachnoidal intergrowth and cysts became apparent both in the relation to of spinal cord and its rootlets. Squeezing brain and its rootlets, they caused the violation of the conductivity of impulses/moments/pulses on the nerve fibers, and stimulating them - gave birth to the pains, frequently very intense. Outbalancing and squeezing vessels, especially vein, they caused the disorders of root and the lymph circulations, which led to ischemia, venous stagnation and edema of brain, its shells and rootlets. Blocking partially or completely sub-arachnoidal space, they led to the heavy disorders of liquor circulation.

The periods of the manifestation of arachnoidites from the moment/torque of wound systematically were not studied.

In the cases checked the earliest onset of the expressed arachnoidal cysts was noted on the 11-15th day after wound. But their so early a development was, apparently rare exclusion. Usually they appeared after 4-5 and more than weeks after wound, i.e. in the period of the begun reverse development of the functional violations, caused by the damage of brain and rootlets. Therefore one of the initial symptoms of developing arachnoiditis was stopping the outlined improvement.

Presence in the sub-arachnoidal space of foreign bodies (wounding shells, bone fragments) very favored the development of arachnoiditis, especially with their localization among the rootlets of horse tail.

The symptoms of arachnoiditis frequently detected tendency toward the progression both in the cross and in the vertical direction. As a result the called by them conductor, segmental and radicular violations grew on in the ratio not only of intensity, but also extensiveness, i.e., connection to the available disorders of now on-s, due to the implication in the suffering of adjacent rootlets and divisions of brain. This build-up/growth of the already available symptoms was considered as important indication of the complication of the bullet damage/defeat of spinal cord of

arachnoiditis.

Under the effect of the series/number of reasons (physical stress, contusions with the incidence/drop, cooling or excessive superheating, infections, etc.), and sometimes also without the visible reasons arachnoiditis frequently suddenly was peaked. Clinically this became apparent sharp/acute reinforcing of available functional disorders, subsequently which were undergoing to a certain degree to reverse development. This remitting course is very typical for arachnoidites of bullet etiology, although it was observed far not in all cases.

The clinical picture of arachnoiditis came forward the more distinctly, the weaker there was the damage of spinal cord, which it complicated. On the contrary, upon the connection of arachnoiditis to the heavy cross damage of spinal cord clinical picture proved to be indistinct, since it little could add to those conductor or radicular violations which already occurred.

The most permanent symptom of arachnoiditis were radicular pains. They are they were usually the more intense, the weaker was disrupted the conductivity of roots and spinal cord. Upon the full/total/complete transverse contaminations of brain they were observed only with the implication in the arachnoidal intergrowth of

the rootlets, entering the spinal cord of higher than the focus. The especially intense pains, which caused to patients frequently strong sufferings, were observed with arachnoidites of horse tail. With the localization of arachnoiditis in the limits of spinal cord, in spite of the heavy character/nature of arachnoiditis, sharp pains were observed rarely. Is explained this by the fact that to a certain degree was simultaneously disrupted conducting impulses/moments/pulses on the spinal cord due to the basic damage/defect.

In the region the bodies of pain carried the encircling or compressive character/nature, in the region extremity-longitudinal, which pulls, which shoots frequently to the pains it was connected the perception of burning, heat, cold. Against the background more or less permanent pains sometimes was observed their paroxysmal reinforcing. Cough, sneezing/popping, physical stresses usually amplified pains, especially, with arachnoidites of horse tail. With the latter/last localization of arachnoiditis the pains frequently were amplified with the overfilling of bladder and rectum, and also during the defecation and the urination.

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Sometimes independent of pains or simultaneously with them in



the region of perineum appeared extremely the painful perceptions of compression, pressure, burning, and in the straight line of intestine-springing-away or obstruction.

With arachnoidites of horse tail with the implication in the suffering mainly of sacral rootlets sometimes was observed the following peculiar disturbance of urination. In all cases there were pains, which appeared in the form of short-time attacks/seizures/paroxysms in the region of perineum. Out of the attacks/seizures/paroxysms the casualties were wet completely freely. But if during the report/event of urination appeared the attack/seizure/paroxysm of pain, then it ceased, disregarding of the pangs of patient; as soon as pain it ceased (separate attacks/seizures/paroxysms were continued on 10-20 seconds), urination was made by completely free, but it again became impossible with the renewal of pains. By the reason for fine delay of urine in these cases was, apparently the sharp reflector spasm of the sphincters of the bladder, bringing about painful stimulations.

The intensity of the objectively stated/established violations of the sensitivity both radicular and conductor character/nature first of all was determined by the severity of the original damage/defeat of spinal cord and its rootlets. Arachnoiditis one way or another amplified them, and during its progressive dissemination

in the vertical direction one way or another it expanded their zone. Sometimes were observed the pains of conductor character/nature. The forced bending of head forward and rapping on the bowed extensions of vertebrae in the region where developed arachnoiditis, frequently produced conductor paresthesia in the form of the perception of the passage of electric current lengthwise along spine also of lower extremities.

With arachnoidites of horse tail and lower divisions of spinal cord frequently was observed Kernig's symptom. With its causing frequently appeared the pain, which was being spread in the ascending direction over the posterior surface of shin and thigh and which was being finished with the peculiar perception of "dispersal and tingling" in the spin at the level of the damaged segment of spinal cord. Sometimes this merited perception or as if passage of electric current was spread also to the contradictory/opposite foot. K. P. Chikovani, who paid special attention to the investigation of this symptom, came to light/detected/exposed it into 60.0c/o of all cases of arachnoiditis of bullet etiology.

Changes in the tendinous and skin reflexes presented nothing characteristic. If the reflexes, realized by division of spinal cord, by included arachnoiditis, up to the moment/torque of its development have already been reduced, then they again weakened or disappeared.

This disappearance or weakening of reflexes was the important sign, which indicated the onset of the complication of wound, in particular, to arachnoiditis. Down from the place of focus tendinous reflexes could be lost, normal or increased.

The disorders of the function of pelvic organs/controls were frequent. The begun reduction of the random or automatic emptying of the bladder in proportion to the increase of arachnoiditis stopped or again worsened.

Cerebro-spinal fluid in the sharp/acute stage of arachnoiditis was changed very frequently. However, changes did not carry the expressed character/nature: the moderate increase squirrel and small increase in cytosis within the limits a few ten cells. Initially predominated neutrophils, into further-lymphocytes. In the chronic stage, and also during the slow development of arachnoiditis cytosis it was frequently normal.

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With the establishment of the full/total/complete blockade of sub-arachnoidal space the content in the cerebro-spinal fluid of protein could considerably be raised. If puncture was conducted afterward more or less prolonged blockade, cerebro-spinal fluid was

frequently xanthochromium, especially during the varicose expansion of the veins of rootlets and brain itself, caused by sausage mode by their arachnoidal intergrowth.

With severe arachnoiditis of horse tail lumbar punctures frequently proved to be unsuccessful. The reason for these "dry" punctures was more or less full/total/complete closing/healing at this level of sub-arachnoidal space.

Blockade of sub-arachnoidal space - very important symptom of arachnoiditis, but not necessary. As with arachnoiditis of another etiology, for example, infectious, after the closed traumata of brain, joint and intergrowth they detected tendency toward the preferred dissemination from the posterior division of sub-arachnoidal space. However, in the front/leading division of this space its cross-country ability to a certain degree was retained. In these cases could occur considerable nonconformity between the degree of the violation of liquor circulation and the severity of arachnoiditis. In order to establish/install the presence of blockade and its degree, sometimes was applied contrast X-ray analysis.

The diagnosis of arachnoiditis did not usually present essential difficulties. Stopping 4-5 weeks after the wound of the outlined improvement, and by the time more deterioration and appearance of

radicular pains forced first of all to assume arachnoiditis, especially when the symptoms of the damage of brain were weakly expressed. Lumbar puncture usually more precisely formulated the correctness of this assumption. As noted above, the absence of full/total/complete blockade did not eliminate arachnoiditis.

For arachnoiditis sufficiently characteristically remitting course, especially during relatively moderate/mild violations of the conductivity of spinal cord and rootlets of horse tail. With the cystic form of arachnoiditis the remissions were observed more frequently and they were expressed more distinct than with the adhesive form.

To differentiate arachnoiditis first of all it was necessary with the fibrous form of the external pachymeningitis, which gradually compresses the sack of solid cerebral shell and the prisoners in it spinal cord and rootlets. But for the external pachymeningitis, in contrast to arachnoiditis, the shock build-ups/growths of phenomena and remission are not characteristic. The upper level of segmental and conductor violations with them is more stable, and the blockade of sub-arachnoidal space occurs more frequently.

Should be considered also the character/nature of wound. With

the penetrating wounds of spine, in particular with the indications of the damage of solid cerebral shell, external pachymeningitis were observed approximately/exemplarily just as frequently as arachnoidites. With the nonpenetrating wounds arachnoidites were observed more frequently than external pachymeningitis.

In many instances the differential diagnosis between these two forms of tunicary complications was unrealizable; moreover, they greatly frequently were observed simultaneously. This did not have vital importance, since both forms were subject to surgical treatment.

Differential diagnosis with the late secondary necroses is not difficult. The latter were observed rarely; radicular pains and the blockade of sub-arachnoidal space with them they were absent.

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Treatment. In the sharp/acute stage of arachnoiditis, and also with its aggravations was conducted energetic treatment by sulfanilamides and penicillin, which gave sometimes a good effect. Were applied also iodide preparations *inside* or it is intravenous in the form 10-20o/o solution of sodium iodide.

In the later periods comparatively extensively were used application of paraffin, salt-water, hydrogen sulfide, radioactive and mud baths. During the use/application of the latter were observed temporary/time deterioration in connection with the aggravation of process. K. P. Chikovani observed considerable improvements after treatment at Tskhaltubo.

Were applied also repeated lumbar punctures with the extraction of considerable quantities of cerebro-spinal fluid. In the opinion of authors' majority, they did not give any essential effect. However, in the presence of blockade they proved to be faster harmful, than useful.

In a number of cases of the partial or full/total/complete blockade of sub-arachnoidal space the author, and also A. N. Bakulev, K. P. Chikovani et al. saw favorable effect from the introduction to the sub-arachnoidal space 15-20 cm<sup>3</sup> of air after the preliminary extraction of the same quantity of cerebro-spinal fluid. In order to hold down/retain the caused by the introduction of air elevated pressure lower than place of blockade, one ought not immediately to extract needle or to hold its opened. The air, which is fixed upward (puncture they must be conducted in the position/situation of patient sitting), it frequently broke thin-walled cysts or tender joints between the soft cerebral shells. As a result was reduced normal

liquor circulation and was removed the pressure of cysts and intergrowth on the spinal cord, the rootlets and the vessels. But in many other cases this method did not give positive effect. Inspection/check on the operating or sectional table showed that the discussion dealt with the massive intergrowth to tear which the air, introduced even under the considerable pressure, not could.

With absence of effect from the conservative therapy they resorted to surgical intervention. But the latter, in particular with the adhesive form of arachnoiditis, did not frequently give any satisfactory results. In some cases this was connected with the fact that the changes in the spinal cord or rootlets, which arose in them at the moment of wound, had stable character/nature, in others - due to the impossibility to completely remove the available disseminated and dense joints and intergrowth. The latter especially frequently occurred with arachnoidites of horse tail. Is the larger, that was achieved in these cases, this decrease of radicular pains.

Spinal arachnoidites in the Great Patriotic War operated comparatively widely. For example, K. P. Chikovani of 110 casualties with arachnoiditis subjected to surgical treatment 51 (44.60/o). Three patients perished after operation/process, in remaining were obtained the following results: a considerable improvement in the motor functions is noted in 10 casualties, improvement - in 21; the



elimination of painful syndrome - in 18, considerable improvement - in 21, improvement - in 5, in 4 sick positive effect it was absent.

The best post-operation result was observed with the cystic form of arachnoiditis and with the moderate/mild restricted forms of adhesive arachnoiditis.

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With nonremovable diffuse adhesive arachnoiditis, which produced sharp painful syndrome, many neurosurgeons with ran to the intersection of the involved in the intergrowth posterior rootlets, and in the especially heavy cases - to the bilateral chordotomy (K. P. Chikovani, A. Ya. Sal'man et al.).

Chronic spinal pachymeningitis ((pachimeningitis spinalis chronica. Epiduritis spinalis chronica). The organization of the damaged epidural cellulose, scraps of yellow ligament and hemorrhages into the epidural space, especially in the presence in it of the infected foci, metallic or bone foreign bodies, led usually to the development of dense ones, rich vascularized Rubtsov. The latter, being gradually compressed, squeezed the epidural cuts of rootlets and the sack of solid cerebral shell with the included in it spinal cord.

In the process of organization epidural scars, squeezing rootlets, gave birth to radicular pains, frequently very intense, and squeezing spinal cord and its feeding vessels, they not only detained the reduction of its conductor functions, but also we could cause their further deterioration. In the spinal cord, in the region of the disposition of epidural ones Ruzicov, into the more last stages frequently were detected fresh ischemic foci. Drawing together rootlets of horse tail, they contributed to their adhesion into one continuous cord/head. Besides this, external pachymeningitis produced the disorder of lymph circulation and especially liquor circulation.

Were localized external pachymeningitis mainly in the posterior division of epidural space, covering solid cerebral shell by swelling. But they could be spread also to the front/leading divisions of the sack of solid cerebral shell, forming its deep circular sausage modes and creating the picture of sand hours. Especially powerful/thick circular sausage modes appeared in the region of horse tail. Cicatricial stratification on the solid cerebral shell could achieve the considerable thickness (1-1.5 cm).

Pachymeningitis, similar to arachnoidites, relate to comparatively late complications. On the autopsies and on the

operating table however serious their forms rarely it was necessary to see earlier than 4-5 weeks.

Pathological changes usually appeared also on the internal surface of solid cerebral shell. were expressed they in the growth of endothelium, pierced by the numerous newly formed vessels. However, by themselves these changes rarely affected adversely spinal cord and its rootlets, but they took active part in the development of arachnoidites.

The isolated/insulated external pachymeningitis were encountered comparatively rarely: approximately/exemplarily in third of cases they were combined with arachnoidites. Their heavy forms appeared not only with the penetrating wounds of spinal canal, but also during the damages of spine, which were not being escorted/tracked by the autopsy of spinal canal. Best prophylaxis of late external pachymeningitis was early surgical intervention, directed toward the sanitation of epidural space and the removal/distance from it of foreign bodies.

In recent years of the Great Patriotic War a number of cases of the bullet wounds of spinal cord, complicated by late pachymeningitis, in comparison with its first years considerably was shortened.

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This fact is explained by the rapid increase of Soviet neurosurgeons' activity in the relation to the contraction/abbreviation of the periods of intervention on the spine and spinal cord and by radicalism during the surgical treatment of these wounds.

Symptoms and coursing of chronic pachymeningitis greatly resembled the same of arachnoiditis. Basic symptom were radicular pains. In contrast to arachnoidites they comparatively rarely achieved large intensity. In proportion to the organization of subtypes of the growths of pain, and equally motor and bladder disorders grew on. The remissions, sufficiently usual with arachnoiditis, with the pachymeningitis were noted rarely. With them more frequently than with arachnoidites, was observed the sickliness in the spine as spontaneous, so especially with the percussion. The forced bending of head in these cases also forward produced pain in the spine.

During the combination of external pachymeningitis with arachnoiditis the percussion or aimed extensions at the level of localization of arachnoiditis was frequently escorted/tracked by the

perception of the passage as of the "electric current", which was being spread lengthwise the spina also of lower extremities.

In the cerebro-spinal fluid the content of protein was increased even when the blockade of sub-arachnoidal space was incomplete or hardly it was expressed. The xanthochromium stain/staining of cerebro-spinal fluid was observed frequently.

On the contrary, cytolysis remained by usually normal, it is thinner/less frequent (mainly with the earlier stages of the development of process) slightly increased. An increase in the content of protein in the cerebro-spinal fluid and the appearance in it of xanthochromia in the cases of pachymeningitis, which did not produce the blockade of sub-arachnoidal space, were explained by sharp venous stagnation in the latter as a result of the compression by the scars of epidural venous web/plexus.

Thought about the chronic pachymeningitis appeared in each case of the penetrating wound of the spine, which was not subjected to the radical surgical perfecting (laminectomy) with which the outlined improvement in the disrupted functions of spinal cord and its rootlets 5-6 weeks after wound stopped, those more if it was changed by deterioration. The appearance of radicular pains, is earlier than been absent, the increased content of protein in the cerebro-spinal

fluid and its xanthochromium stain/staining, presence in records of the history of illness within the preceding period of indication of epidural hematoma, transferred sharp/acute suppurative pachymeningitis, cured osteomyelitis made assumption about the possibility of chronic pachymeningitis very probable. This assumption acquired the even higher degree of likelihood, if radiographically in the lumen of spinal canal were detected bone fragments or metallic bodies, at least and fine/small.

As showed the experiment/experience of the Great Patriotic War, the differential diagnosis between chronic fibrous pachymeningitis and arachnoiditis is very difficult. Under other similar conditions in favor of pachymeningitis she spoke the local sickliness of spine with the percussion, absence or weak manifestation of remissions, the high content in the cerebro-spinal fluid of protein with the incomplete blockade of sub-arachnoidal space and xanthochromia in it.

If the reabsorbing therapy (see arachnoidites) it did not give positive effect, then was applied surgical intervention. Unfortunately the radical removal/distance of fibrous growths hardly ever proved to be attainable.

Most favorable results were observed in ring-shaped or half-ring-shaped Rubtsovs' cases and sausage nodes of the sack of solid cerebral shell. Carving or even simple dissection of these sausage nodes led to expansion of the compressed sector of the latter, to the reduction of liquor circulation and the elimination of their pressure on the spinal cord or the horse tail.

If Rubtsov changed tissues of epidural space could not be removed, and radicular pains were very intense, neurosurgeons sometimes resorted to the subdural cutting of posterior rootlets or to the chordotomy.

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#### Chapter V.

Rendering aid by that wounded the spine and the spinal cord in different stages of evacuation.

Rendering aid by all casualty in different stages of evacuation was basic and primary task of the entire military medical service of Soviet army during the Great Patriotic War. In view of diversity and severity of the wounds of different regions of human body were necessary different methods and receptions/procedures of rendering to this aid. The wounds of central nervous system required an even larger specificity in the rendering to this aid, that also led to the organization of neuro-surgical service in the system of the military medical service. Different in severity and character/nature of the wound of spine and spinal cord, and also the associated wounds of other organs/controls and systems; different sanitary-tactical circumstances in one or the other front sector; the structural special features/peculiarities of therapeutic institutions in



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different areas of military medical service - all these factors determined tactics and behavior in the relation to rendering to therapeutic aid in each stage of evacuation.

Army area.

Clinical characteristic of those wounded a spine and a spinalcord in the army area.

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In the army area those wounded the spine and the spinal cord usually were observed into the first hours after wound and only in view of the exceptional conditions of a sanitary-tactical circumstances these casualties sometimes were detained in this area of more than days. Under the normal conditions of the combat circumstances in the army area were detained only nontransportable whose evacuation to further stages was strictly contraindicated.

Clinical picture with the wounds into the spine and the spinal cord in the army area was very diverse, depending on the level of wound, character/nature of the damage of spine and spinal cord, combination of the wound of spine with the wound of other organs/controls and areas, and also on the time, which passed from the moment/torque of wound.

Together with the easily wounded, who independently attached to the regimental medical aid station, in whom there was a wound only of extensions of vertebrae, there was a considerable number of those obtained heavier wounds. These casualties completely cannot be moved due to the full/total/complete immobility of body lower than the level of wound.

With the wounds of spine and spinal cord in the neck division the casualties frequently lost consciousness.

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After arriving into the consciousness, they usually for the first hours and even days were flaccid, apathetic to entire that surrounding. As a result of the absence of pains in the significant part of such casualties (spinal and traumatic shock) and of the general/common/total suppression of psyche/psychics they more frequently lay/rested quite quietly, not on that complaining and without realizing to the entire severity of its position/situation.

Following the wound of spinal cord were always developed the disorders of movements and sensitivity. In the vast unit of such casualties this was expressed in paralyses, usually flaccid.

In some those wounded the spine and the spinal cord soon after disappearance of shock phenomena, and sometimes also in the presence their, appeared sharp radicular pains (wound of horse tail), why casualties behaved very restlessly: they shouted, complained about the sharp pains, requested about the immediate aid.

The damage/defeat of spinal cord was always escorted/tracked by violations from the side of pelvic organs/controls: clinically this most frequently was manifested in the form of the delay of urine and feces.

With the associated wounds, the especially thoracic and abdominal area, skull, etc., clinical picture was even heavier, and frequently also threatening.

In the army area those wounded the spine and the spinal cord in connection with the heavy clinical picture and the difficulties, connected with the care of them, they needed rapid and good classification and the evacuation into the rear, that persistently dictated the nearness of line or fire, need in the specialized aid with the very restricted possibility of its rendering in the army area.

Therefore with wounds of spine and spinal cord a basic question

in the army area was the primary defense of wound, carrying out/removal from the field of breakage and correct evacuation classification of these casualties.

First aid by that wounded the spine and the spinal cord and carrying out/removal from the field of breakage.

According to the data of the materials of the development of the histories of disease/sickness/illness/malady, the first aid on the field of battle was shown/rendered soon to the vast majority of casualties. With the wounds of spine a precise period of rendering of first aid is known with the nonpenetrating wounds in 70.10/o, while with those penetrating - in 65.70/o of all casualties and in all years of war. Detailed information according to these data is given in Table 49.

Given data show that more than 85.00/o all casualties during entire period of war obtained medical aid in the first 3 hours.

Table 49. Periods of rendering, to the first medical aid by that wounded the spine and the spinal cord during entire period of war. (in the percentages to a total number of casualties in all years).

(1) Характер ранения	(2) Немедленно	(3) Через 1-3 часа	(4) Через 4-6 часов	(5) После 6 часов	(6) Не оказана	(7) Всего
(8) Непроникающие	67,3	18,2	6,0	7,6	0,9	100,0
(9) Проникающие ...	64,0	22,2	4,6	8,5	0,7	100,0

Key: (1). Character of wound. (2). Immediately. (3). After 1-3 hours. (4). After 4-6 hours. (5). After 6 hours. (6). It is not shown/rendered. (7). In all.

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Remaining aid was shown/rendered within the later periods, and only 0.90/o of those obtained nonpenetrating and 0.70/o of those obtained penetrating wounds remained without the first aid. This usually related to the casualties, which were completely immobilized and they were located in such places, whence to remove them without the cover of night it was impossible, why casualties remained on several/somewhat hours on the spot of wound.

Timely rendering of first aid on the field of battle frequently impeded still the fact that the unit of these casualties was in heavy or unconscious state and could not answer the challenge of orderlies

on the field of battle, remaining to the known moment/torque of that not notice. The searching such of those wounded the spine and the spinal cord helped the "mopping-up" of the field of breakage. Bulk of such casualties obtained aid either by way of mutual assistance or it exerted aidmen, sanitation instructors and feldshers. The presence of this contingent of persons into different periods of combat operations/processes and voltage of breakage itself, it is doubtless, they noticeably influenced rendering aid by casualty on the field of battle.

The character/nature of bandage depended on the value of wound and on that, who it laid. It is completely understandable that the soldier, that laid bandage by way of mutual assistance, could use only the available to it first aid kit. If aid is exerted medical personnel, who had available usually the bandages of different sizes/dimensions, then was used bandage with respect to the value of wound. Entire medical personnel was well and thoroughly instructed about the extreme importance of the correct imposition of the primary bandage, which frequently solved the fate of casualty.

During the Great Patriotic War the carrying out/removal from the field of the breakage of casualties, including wounded the spine and the spinal cord, was realized by different methods, which completely depended from the character/nature of combat operation/process and

distance to BMP or PMP, and also from the presence of one or the other transport means. The method of carrying out/removal depended on the season, area relief and presence or absence of forests/scaffolding. Thus, in winter at all fronts were applied drags and thinner/less frequent canine harnesses. In summer, if was allowed locality, were utilized stretchers, overcoats, ponchos and the same canine harness. Under the severe conditions for breakage in the absence the covers at any time of the year of casualties carried "on themselves". It is necessary to say that, as showed the experiment/experience of war, the carrying out/removal of those wounded the spine "on themselves", and it is also on the cape-tent undesirable, since unavoidable with these methods of carrying out/removal movements and bends of spine can sharply impair the condition of the wound of spinal cord. Is more preferable carrying out/removal on the stretchers, especially with the solid lining, on drag, canine harness under the condition of sufficient fixation of casualty.

The experiment/experience of the Great Patriotic War gives the already full/total/complete basis to speak about need and usefulness of differentiation of the methods of the carrying out/removal of casualties from the field of breakage and their delivery/procurement to the battalion and regimental medical aid stations.



First of all was necessary cautious extraction of wounded from under the fragments of defensive installations, application of aseptic dressing on the wound, the creation of the conditions, which facilitate respiration for victim (to unbutton the winch of overcoat, service shirts, belt/sling, to remove shoulder sack, etc.), the immobilization of spine by improvised means and the subsequent carrying out/removal from the field of breakage into the cover or to the nearest point/post of medical aid (BMP, PMP).

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Putting to use for the carrying out/removal from the field of breakage stretchers, aidmen with the suspicion to damage of spine (pain in the field of spine, paralyses) as far as possible created the conditions, which eliminate the sagging of the body of casualty. For this under the back of casualty they laid straw, packs/rolls of overcoat or branch, panel, if the latter proved to be hereabout. If such possibilities there was not, but at aidmen's disposal there were soft stretchers, in the series/number of fronts aidmen, according to the obtained indications, they moved those wounded the spine in the position/situation on the stomach. In the cold time

← it was <sup>very</sup> important to shield such casualties from the cooling.

Medical aid by that wounded the spine spinal cord on BMP and PMP.

The delivery/procurement of those wounded the spine and the spinal cord on BMP and PMP always depended both on their distance from the line of fire and from the reliability of the cover of evacuation routes. In the wooded countries of casualties they usually evacuated from the loculi/nests of the collection by horse transport, thinner/less frequent in the vehicles. With the open routes/paths and the impossibility of the entrance of casualties they carried far on the stretchers or evacuated on the canine harnesses, in winter - on drags. In spite of the difficult conditions for combat operations/processes and frequently sufficiently heavy sanitary-tactical circumstances, on the data of the test of the Great Patriotic War, for PMP for the first 2-5 hours they supplied/delivered/fed into to 80.00/o of those wounded the spine and the spinal cord.

Rendering to the first medical aid dependence on the combat and sanitary-tactical circumstances it was conducted on BMP or on PMP. In the vast majority of the cases this aid was reduced to correction or application of newly shielding dressing, it is considerably thinner/less frequent to cessation of hemorrhage and taking permissible antishock measures (morphine, vodka, etc.). From the second half of 1942 in the cases of need and under the favorable

conditions the conditions of combat circumstances on PMP produced blood transfusion. To the antishock measures with the wounds into the spine and the spinal cord more frequently they resorted, if they were combined with the wounds of chest or abdominal area, as as with the isolated/insulated wounds of spine and spinal cord shock phenomena were observed sufficiently rarely.

In the cold season in PMP special attention was focused on the heating of that wounded into the spine and the spinal cord.

On PMP, as a rule, it was conducted no surgical interventions on the spine and the spinal cord, but it was conducted or, it is more accurate, began the medical classification of casualties, which established/installed the first priority of aid and the place for the evacuation of that wounded into the spine and the spinal cord.

The evacuation of casualties with PMP to the subsequent stages also depended from sanitary-tactical conditions, distance to the rear therapeutic institutions. Thus, in the beginning of the Great Patriotic War in view of combat and tactical situation frequently the evacuation of casualties was conducted in stages DMP, KhPPG or EG, then from the second half 1942, when was correctly organized the specialized neuro-surgical aid, in all armies at all fronts it was organized the export of those wounded the spine and the spinal cord

directly into specialized KnPPG of army in the specially commissioned transport of the sanitary service of army.

The volume of measures for prophylaxis of complications in those wounded the spine and care of them in the medical institutions of army area was to a considerable extent determined by the special feature/peculiarity of wound.

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Under all conditions on PMP took the measures to heating of casualty and prophylaxis of wound infection (correction of bandage, dress/lavatory of wound, aseptic bandage). In the same stage was conducted the catheterization of the bladder in the case of the delay of urine.

During the evacuation of these casualties in the cold season took the corresponding measures for prophylaxis of the freezings of the paralyzed units of the body in the route/path - wrapping into several blankets or "sanitary envelope" of the type of sleeping sack, especially during the evacuation by aircraft. The careful wrapping of the similar casualties had very important value, since due to the loss of sensitivity these casualties easily were subjected to freezings.

Medical aid by wounded the spine SI spinal cord on DMP.

Division medical aid station in different periods of war exerted those wounded the spine and the spinal cord of different volume aid. Being the medical institution, on which began the rendering of present surgical aid to the majority of casualties, DMP had to render aid including certain those wounded the spine and the spinal cord. However, rendering aid by that wounded the spine and the spinal cord during the entire Great Patriotic War was considerably changed the dependence not only on the character/nature and the special features/peculiarities of combat operations, but also on gaining of experience on the treatment of the similar casualties.

In the beginning of the Great Patriotic War when that specialized by aid in the stages of evacuation yet did not have the solidly manufactured installations, many wounded the spine and the spinal cord underwent on DMP the primary processing of wounds equal with those obtained the wounds of other units of the body. Thus, according to the data of the development of the histories of disease/sickness/illness/malady, about 60.00/o of all dissections, produced during the war, were made on DMP. Almost the half bone fragments and about 40.00/o of metallic fragments are also removed on

DMP. On DMP it is produced only by 7.60/o of all laminectomies made for entire war, moreover this relates exclusively to the first months of war. A reduction in the percentage of operability on DMP illustrate well the data of one of the fronts (chief surgeon of the front I. N. Ishchenko) in the first half-year of 1943, when along the front, was organized the specialized aid fully. The total operability, which was equal to 40.00/o was distributed on the months thus: January - 14.80/o, February - 30.0/o, March - 54.70/o, April - 68.00/o, May - 49.00/o, and June - only 21.30/o.

Those wounded into the spine and the spinal cord entered on DMP usually in the general/common/total flow of the wounded, going from regimental medical points/posts.

In the beginning the wars having entered into the sorting separation/section DMP of that wounded inspected, depending on general condition and condition of bandage, supplied/delivered/fed — into the medical dressing room or the operating room; in the presence of general/common/total readings performed primary processing the wounds, in the majority of the cases in the form of its dissection, and then this casualty they rapidly evacuated into the rear institutions.

In the unit of the cases the primary processing of wound

initiated in the form of dissection converted/transferred into the carving of crushed tissues, and the striking in the wound fragments, especially metallic, were driven out from the wound. By this is explained the given higher percentage of the removal/distance of foreign bodies on DMP.

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Still thinner/less frequent this involuntary wide primary processing of wound converted/transferred in the removal/distance of large and numerous fine/small bone fragments - the broken small arcs of vertebrae - in the operation/process, which carries many lines of laminectomy. From the second half 1942, when the organization of the specialized neuro-surgical aid already became sharp and when were manufactured special readings to the primary processing of wounds or production in radical interventions of the type of laminectomy with the wounds of spine and spinal cord, on DMP the percentage of surgical interventions with these wounds was lowered.

The special group of the wounds of spine and spinal cord presented the combined wounds of spine and thoracic or abdominal area, with which was always required urgent intervention the means of abdominal incision or sewing up of pneumothorax.

Such wounds it was with the wounds of thoracic division 52.70/o and lumbar- sacral - 32.30/o of all wounds of the corresponding divisions of spine. In more detail these wounds are represented in Table 50.

Given data show that the known unit of those wounded the spine and the spinal cord, in which the wound simultaneously was counted with the wound of the organs/controls of thoracic and abdominal area, they were subject to operation on DMP, since on their character these wounds were urgent and threatening the life of casualty. These wounded, operated under conditions of DMP, it was necessary to hospitalize for the certain period of time. Thus, after laparotomy/ceiotomy hospitalization was continued not less than 8-10 days, but in the case of any complications it is longer. During the sewing up of pneumothorax the period of hospitalization was shortened to 4-5 days. However, in the case of complications such casualties were made by nontransportable ones and had to longer remain on DMP, sometimes to the month. This forced operational aid apropos of the associated wound and especially appeared after this complication drew off the periods of surgical intervention on the spine and required organization on DMP of the corresponding care of those wounded in spine which greatly complicated work DMP.

Since 1943 was isolated one additional group of casualties,



which for the most part had to be operated on DMP for the purpose of prophylaxis of uro-infections, casualties with the damage of spinal cord and the delay of urine. In this group of casualties produced the high section of bubble - cystotomy - for the removals/diversions of urine.

Table 50. Frequency of some combined wounds of spine and adjacent regions (in the percentages to a total number).

(1) Уровень ранения позвоночника	(2) Сочетанные ранения			
	(3) лица	(4) шеи, проникающие	(5) груди, проникающие	(6) грудобрюшные, живота и таза, проникающие
(7) Шейный отдел . . . . .	7,7	3,4	7,9	0,4
(8) Грудной » . . . . .	0,4	0,2	32,2	3,7
(9) Пояснично-крестцовый отдел . . . . .	0,2	0,1	3,0	15,4

Key: (1). Level of the wound of spine. (2). Combined wounds. (3). faces. (4). necks, that penetrate. (5). breasts, which penetrate. (6). chest-abdominal, stomach and pelvis, that penetrate. (7). Neck division. (8). Thoracic. (9). Lumbar- sacral division.

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For entire Great Patriotic war urine-bubble fistula was superimposed by 20.00/o of those wounded the spine and the spinal cord, and them 4.00/o of all cystotomies were produced on DMP. However, the frequency of this operation/process was very different, although its number with each year of war all grew/rose.

Departure/attendance on DMP. Taking into account that on DMP were detained the predominantly casualties with those combined injuries of spine and cavitary organs/controls, and also casualties

in the condition of shock or nontransportable, care of them it presented special difficulties.

However, from first or days took the measures of prophylaxis of bedsores, pneumonia, complications from the side of the bladder, and also the wound infection.

In casualties, who did not be subject to delay to DMP, preventive measures were reduced to the heating, the control inspection of bandage or wound, the catheterization of the bladder and to correction or to imposition in the shown cases of the immobilization of the corresponding division of spine.

In the institutions of the army area of such casualties they evacuated on the rigid stretchers in the position/situation on the spine.

Medical aid by that wounded the spine and the spinal cord in the army area.

Organization in hospitals of the army area (GBA) of surgical aid by that wounded the spine.

From surgical hospitals or army area singled out the separate

hospitals (KhPPG) whose substances equal with other separations/sections was created the specialized neuro-surgical they were isolated due to the attachment of the corresponding staff of the specialists of ORMU [OPMY - separate medical reinforcement company] with the equipment, the necessary instrumentation and the X-ray apparatus.

The majority of armies had 2-4 such KhPPG for the work on two directions.

Under conditions for strained combat with an increase in the number of entered casualties neurosurgical institutions of army region (GBA) temporarily supplemented by the groups of reinforcing from front line basis (GBF).

The volume of the work on specialized KhPPG and evacuation hospitals of army region to a considerable extent depended on sanitary-tactical conditions in each this front sector. Under conditions of maneuver defense and disengagement, while in certain cases also during the rapid advance of the units of this front sector forward these institutions are frequently forced were to fulfill the functions of general-surgical hospital. Wounded the spine under these conditions they hospitalized only from the life readings, and they operated only from the urgent readings.

Field mobile hospitals GBA proved to be sometimes at a distance of 50-80 even more than kilometers from the front line, and evacuation hospitals GBF - to 150 and more than kilometers. The more was driven out the front, the more volume of work fell on specialized KhPPG of army hospital basis (GBA).

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Under conditions of rapid movement of army when the groups of reinforcing are present, and during the equipment with X-ray apparatus the neurosurgeons attempted to operate those wounded into the spine as far as possible radically in KhPPG in order to free them from the early evacuation along the poor roads; furthermore, under conditions of the advance of the army forward of KhPPG actually ceased to be the same, being driven out from the front, while other specialized army hospitals by sand bar they were transported forward (B. A. Regal'skiy, A. S. Orlovskiy et al.).

Thus, problem of the volume of the specialized neuro-surgical aid in army region and about that, when should be performed radical surgery in those wounded the spine, it was not possible to solve dogmatically: either all casualties to operate in the army area or

all casualties to operate in the specialized evacuation hospitals of front rear (GBF).

Under the favorable sanitary-tactical conditions specialized separations/sections KhPPG or army area had available all necessary conditions for the radical surgical processing of those wounded the spine. However, there is no doubt that these conditions were more favorable on GBF.

In particular, the hospitals of front rear were usually equipped by the X-ray installations of large power, and also next laboratories, which helped the selection of medicinal substances and the timely recognition of different complications. Consequently, under the condition of a comparatively not far arranged/located hospital basis of front and satisfactory substances of trans-perspiration taking into account the condition the wounded more advantageous it was those wounded the spine as early as possible to evacuate on GBF, having maximally shortened a quantity of stages of evacuation. Basic means of surgical intervention in these areas was the expanded radical surgery of the type of laminectomy with intervention on the spinal cord and its shells.

General/common/total characteristic of those wounded a spine and a spinal cord in the army area.

Wounded into the spine and the spinal cord entered the therapeutic institutions of army area usually in the sharp/acute period of wound 1-3 days after wound. Certain unit of such casualties after the admission was in the state of shock.

Furthermore, into the specialized hospitals of army area entered frequently those wounded the spine and the spinal cord which on DMP produced one or the other operation/process apropos of pneumothorax or apropos of the wound of abdominal area.

They here usually guided such casualties as previously are recognized themselves nontransportable and they maintained/withstood several days on DMP and in KhPPG or the first line. Consequently, already under conditions of the specialized by KhPPG army area those wounded into the spine and the spinal cord were located in different periods of the course of wound process. Hence ensued/escaped/flowed out need and possibility of one or the other surgical intervention. Should be emphasized also the fact that for the surgical treatment of those wounded the spine and the spinal cord to a considerable degree influenced also the overloading of specialized KhPPG by casualties generally, also, in particular wounded the skull whose number always considerably prevailed and to which in vast majority of cases the

Doctors gave known preference. True, this preference was to a certain extent forced and was explained by the fact that in those wounded into the brain more rapidly appeared the more pronounced picture of heavy wound, which was becoming apparent frequently in the violation of the vital functions of brain.

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Wounded into the spine and the spinal cord in the army area in view of this were covered by the specialized aid not fully.

In specialized KhPPG of army area in the vast majority of cases entered those wounded the spine and the spinal cord, whose wounds were isolated/insulated, or such, in which available combined or combined wounds to a greater or lesser extent were eliminated and they were not leading. But they influenced to a certain degree the general condition of casualties. Furthermore, the unit of those wounded the spine and the spinal cord had the series/number of the complications mainly of infectious character/nature, requiring independent intervention, which usually detained intervention on the basic focus. Therefore readings and contraindications to surgical intervention were determined: a) by the possibility of a precise recognition of the nature of the wound of spinal cord (neurologic, surgical, roentgenological examination/inspection) by b) by absence



or by presence of urgent interventions or complications (hemorrhage, infectious complications), c) by distance from KhPPG of armies to the specialized agencies of front (GBF), etc.

From the point of view of readings to the operation/process on the spine basic were the data, which spoke for the compression of spinal cord or its rootlets or the presence of comparatively easily removed foreign bodies in the spinal canal, and also infectious complications.

The periods of the admission of those wounded into the spine and the spinal cord and envelopment by their specialized aid in the army area sufficiently considerably varied in different operations/processes and in different periods of war. Thus, according to the data, obtained during entire period of war, surgical interventions on the spine according to the type of laminectomy with the removal/distance of bone fragments, of foreign bodies and the revision of the contained spinal canal are produced within the following periods: to the first day - 6.5%, to 2-3 days 23.90/o, to the 4-10th day - 34.80/o, from the 11th day to the month - 23.90/o, later than the month 10.90/o.

As can be seen from given data, third of those wounded into the spine and the spinal cord entered from KhPPG and were operated during

the first three days. Second third of casualties entered more lately, on the average to 10 days when it was operated. This exactly was mainly the group of the casualties, who required careful examination/inspection and observation or after operations/processes apropos of the combined wound or the organs/controls of thoracic either abdominal area or their holding on DMP in connection with the severity of general condition. They were headed already for the operation/process apropos of the wound of spine and spinal cord. And, finally, remaining casualties entered and the were operated on in a month and more. This group consisted in essence of casualties with the complications or converted from other general-surgical hospitals where they were located for a long time as nontransportable.

The operability of those wounded the spine and the spinal cord in the specialized hospitals of army region during different periods and years of war was also very diverse, but in the course of time it steadily was raised, it acquired the more correct organized character/nature and became more radical. According to the data of the series/number of reports during different periods of war it is established/installed, that the operability of those wounded the spine in the hospitals of the southwestern Front in the first half of 1943 achieved 13.80/o (I. N. Isachenko), in 1944 - 16.80/o, and at the end of the war it achieved 53.00/o.

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Given data show, as gradually operational aid by that wounded the spine and the spinal cord it was raised and it achieved full/total/complete development.

However, it should be noted that the operational processing of this type of casualties depends on the combat circumstances, the overloading of the specialized hospitals by neuro-surgical casualties and on the conditions of the evacuation of casualties. Thus, in the periods the calms of such casualties almost all operated in the army area. In the absence of these possibilities of such casualties they guided into the front line therapeutic institutions.

Departure/attendance and preventive measures in the specialized hospitals of army area achieved large completeness. Measures on departure/attendance and prophylaxis of different complications in those wounded the spine and the spinal cord in the specialized hospitals of the army area where the casualties were detained by the more prolonged period, they required narrower than the appropriate organization. Here first of all were taken measures for the correct arrangement of casualty.

Position/situation of casualty in the bed. With the bullet

wounds as during the closed damages of spine, to avoid the sagging of body and displacement of the damaged division of the spine of casualties placed to the rigid bed with the wooden panel under the thin separating flask. In reclamation cushions under the damaged division of spine with the bullet wounds its neurosurgeons, as a rule, did not resort.

Only with the wounds of the neck division of the spine of casualties they placed to the usual bed without the panel under the separating flask, but under the condition of the immobilization of the damaged division of spine by gypsum or cardboard cast or by wire splint.

Stretching with the bullet wounds of spine, as a rule, was not applied.

For prophylaxis of bedsores under a sacral-buttock region they laid rubber circle, and under heel - annulus from cotton, wrapped up by gauze. In the cases of paralyzes, which were disseminated also to the upper extremities, such annuli laid also under the elbow joints.

With the rapidly developing bedsores of casualties they placed to the air or water separating flask. The inconvenience of the latter consisted in the fact that was necessary 2 times to add hot water in

connection with its cooling. Under the slightly bent in the knee joints lower extremities laid the cushions.

For the purpose of prophylaxis of bedsores in the sectors, which are directly adjacent to the bed, was applied the tanning of skin by camphor alcohol, ammonium hydroxide (0.50/o solution), alcoholic or aqueous solution of tannin, etc. If according to the character/nature of wound hygienic baths proved to be impossible, entire body of wounded was shaved by 0.25-0.50/o solution of ammonium hydroxide.

For prophylaxis of bedsores, and also complications from the side of organs/controls the respirations in the majority of hospitals frequently changed the position/situation of casualties in the bed. Position/situation on the stomach of casualties with the superpubic fistula required attachment in the matrices/dies in the form of special cuts. Neurosurgeons permitted to casualty and position/situation on to side, not to time having revealed/detected the adverse effect of this position/situation. For this purpose in the army institutions of the series/number of fronts early was applied the therapeutic exercise with the utilization of active and passive movements.

For prophylaxis the contractures of foot, as showed experiment/experience, put to use the gypsum longset bandages, which fix foot in the physiological position/situation.

Taking into account the violation of trophic system in casualties, was necessary daily to remove/take casts for the inspection of feet and wiping of skin to avoid the formation of bedsores.

Care of intestine. Essential difficulties presented care of intestine in those wounded the spine with the damage of spinal cord or horse tail. The delay of chair/stool with such wounds was almost regular.

Paralysis of intestine, and also spastic contraction/abbreviation of the sphincters of rectum, to the reduction of automatism, led to such firm constipation, that conventional means in the form of cleaning enema or laxative at the conventional doses proved to be in this case ineffective.

FOOTNOTE 1. Cascara sagrada (1 tea spoon), Inf. fol. Sennae (2 tea spoons), paraffin oil, phenolphthalein, etc. ENDFOOTNOTE.

Were necessary to resort to the high siphon enemas, the enemas with

the admixture/impurity scaps or vegetable oil usually in combination with the laxative salt.

With the groundlessness of such substances it was necessary to resort to the mechanical cleaning of the ampule of rectum with the aid of the finger/pin or the special narrow blunt-ended, thick-walled spoon. This directly following after the mechanical removal of the deteriorating feces from the ampule of rectum cleaning enema usually proved to be effective.

Individual surgeons at different fronts applied for this purpose stimulating vegetative nervous system substances as pituitrin, physostigmine. During the development of automatism of rectum and in the absence of a feeling of urge to the emptying of intestine it was necessary patients to systematically hold on the underneath rubber sound. Faience and metallic the sound for this purpose are unsuitable, since they can cause bedsores.

The reflector departure/separation of feces and the irretention of gases remained sometimes and for the prolonged period after wound, to the late and residual period inclusively.

More rarely were observed other complications, connected, apparently with constipation as the sharp/acute expansion of stomach,

stable hiccup and difficulty of respiration. Latter/last complications more frequently were observed with the wound of the neck or upper- thoracic division of spine.

With the hiccup proved to be effective the vagosympathetic blockade. With stable meteorism surgeons' majority, except conventional means, somehow: venting tube, enemas of the physiological or hypertonic solution of common salt siphon -enemas, etc., they resorted and to the washing of stomach (G. A. Gomzyakov) or to the subcutaneous (or intramuscular) introduction 1 cm<sup>3</sup> of pituitrin. If necessary the pituitrin was introduced repeatedly after 5-6 hours.

Individual surgeons and neuropathologists successfully put to use also the injections of physostigmine, proserin and to that of similar cholinergic substances.

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Nourishments. The violation of the metabolism and, in particular, of processes of assimilation and destructive metabolism in those wounded into the spine with the damage of spinal cord, and also the loss of proteins in the discharge of the pitted surfaces of bedsores, against the background of frequently considerable blood



losses outside (through the wound, the bladder) and inside (predominantly into the pleural area), very exhausted casualties and created supplementary problem their correct nourishments.

Taking into account the considerable losses of protein, by these casualty, as a rule/handspike, did not decrease a quantity of protein in the food. In this case it was always necessary to approach the utilization of the most easily assimilated proteins. In the ration of those wounded into the spine entered milky products in the form of the milk, cottage cheese, cheese, sour cream, etc., and also meat, eggs. Turned also serious attention to the supply with their verdure and fresh vegetables. At the small doses (at the separate fronts) was given alcohol. Moreover, wounded the spine obtained the vitamins of complex B and C at the preventive doses.

Under all conditions the organization of care of those wounded the spine was thoroughly thought out and it was systematically conducted in connection with each specific case of wound.

Although in the majority of the cases the onset of different complications, and also of initial ones reverse development they depended on the character/nature of the damage of spinal cord and reversibility of changes in them, nevertheless, as showed the experiment/experience of the Great Patriotic War, the organization of

early care, especially in the sharp/acute, early and intermediate period of wound, prevented or considerably damped the course of complications and thereby it improved the issue of wound.

Rendering to the medical aid by that wounded the spine and the spinal cord in the front line area.

The organizational structure of the specialized evacuation hospitals of front line area, which was being conducted in the period of the Great Patriotic war, was characterized by the fact that in the vast majority of front line areas were organized either the large/coarse separations/sections or even whole separate hospitals for those wounded the spine and the spinal cord. These therapeutic institutions served the special states/staffs of the experienced neurosurgeons and neuropathologists. Casualty, who struck into this institution, always obtained the highly skilled aid. The complex examinations/inspections of casualties contributed to correct recognition the character/nature of the damage of spinal cord and to timely operational intervention.

Peculiarity and special feature/peculiarity of different combat operations/processes, condition of evacuation and distance of the specialized agencies of front from the army ones conditioned the admission of different contingents of those wounded the spine and the

spinal cord. Thus, is very well known the fact of the prevalence of casualties into the neck and thoracic division of spine in the army area in comparison with the front line, where frequently predominated those wounded the spine and into the spinal cord at the level of lumbar and sacral division.

The character/nature of medical aid in the front line area was expressed, on one hand, in primary radical intervention on the spine - with laminectomies, in delayed or late primary or even reworking of wound, and on the other hand, in treatment and prophylaxis of different complications, sufficiently which rapidly appeared in casualties with the violation of the function of spinal cord.

The condition of those wounded the spine and the spinal cord was conditioned to the larger degree on the periods of the admission of casualties into the front line institutions. thus, in the series/number of the fronts where in view of combat and sanitary-tactical circumstances front line institutions were arranged/located very close to army ones and even army, a considerable quantity of casualties it entered on the first whereas day. This position/situation was observed in the first period of war. In the second period of the war when the Fascist troops/forces invariably/unchangedly retreated under the onset of Soviet army, in the beginning of all combat operations/processes front line

institutions were supplied to the line of the army ones of the first line, such all casualties very rapidly and early entered front line institutions directly from the army area.

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Sometimes in the specialized agencies of front line area were saved/accumulated wounded the spine and the spinal cord in all periods wounds with the diverse complications. During this period of the workers of these institutions was required large ability and experiment/experience in order to correctly establish/install diagnosis, and also need and advisability of one or the other surgical treatment.

Clinical characteristic of those wounded a spine and a spinal cord in the front line area.

The degree of remoteness from the line of combat operations and condition the evacuations of casualties from the forward areas were the decisive factors, which defined classification, general condition of these wounded the spine and the spinal cord, and also clinical characteristic casualties in the institutions of front line area.

It should be pointed out that in the majority of the periods of combat operations for the front line institutions was characteristic the presence of those wounded the spine and the spinal cord, already several those sorted out in the preceding/previous stages. The obtained extremely heavy wounds of the upper half spinal cord for the most part remained in the advanced stages as nontransportable, wounded into a lumbar-sacral region more frequently they evacuated against the front line area. The character/nature of the wounds of spinal cord and the presence or one or the other complications made it possible to divide such casualties into several groups.

The first, heaviest group composed casualties with the the full/total/complete break of spinal cord not one or the other level of spine. Such casualties always had paralyses of lower extremities, bedsores on the protruding parts of the body and damage of the function of pelvic organs/controls. Even in the absence of any other complications it was necessary to solve a question about effectiveness for these casualties and, consequently, also the indications of surgical intervention.

Furthermore, they needed extremely careful care of themselves. The connection of one or the other suppurative complications even more greatly worsened the general condition of these casualties.

The second group of casualties composed the obtained wounds of spine with the partial damage of spinal cord. On the whole this group of casualties even with the infectious complications was lighter, unless there was the sharp painful or inflammatory complications, which required urgent surgical intervention.

Third group - wounded the spine and the spinal cord with the presence of infectious complications in the form of meningitis, meningomyelitis, abscess, etc. These complications were sometimes such terrible that they became leading and pressed back to the background wound itself.

Finally, four-group - operated in the foremost stages evacuations and required conservative treatment for elevating the vital forces of organism.

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The periods of the admission of those wounded the spine and the spinal cord into the therapeutic institutions of front line area in contrast to the army varied in the sufficiently wide limits - from several days to several weeks and even months. Then it is possible to say, also, relative to the operability of these casualties. Between these two phenomena on the whole there was an inverse dependence:

those early acted wounded more frequently they supplied/delivered/led into without the operational processing, and delivered within the later periods more frequently subjected to that or other surgical processing in the foremost stages evacuations. This is explained by the fact that in all armies were army specialized hospitals in which with respect to their possibilities operated these casualties with the subsequent hospitalization on 15-20 days, depending on severity the wounds, the type of operation/process and post-operation course of wound process. Thus, the usual average period of the admission of the significant part of those wounded the spine and the spinal cord into the front line area was calculated in 2-3 weeks. This is evident from the reports of individual institutions. Thus, according to the reckoning of one of such institutions in the second half-year of 1944 casualties entered on the 3rd day - into 13.10/o of cases, on the 4-5th day - into 5.20/o, on 6-9th day - into 28.10/o, on the 10-15th day - into 13.00/o it is later than 15 days - into 35.60/o of cases.

Given data show that in this institution clearly were secreted two periods of the admission of the casualties: early - to 6-9th day and later - after the 15th day. The first wave of admissions - this casualties, who entered during the height of the combat operation/process when the unit of the casualties entered from army regions not operated. The second wave is caused by the admission of the casualties, evacuated after operation/process.

The considerable oscillations of the admission of casualties were noted at all fronts.

A question of the operation of those wounded the spine and the spinal cord in the front line area is very important, and virtually surgical work frequently oscillated over wide limits.

To this oscillation had essential effect the presence and efficiency of the specialized neuro-surgical agencies of army area. If army institutions performed considerable surgical work, then the latter in the front line institutions was decreased.

Envelopment by the specialized neuro-surgical aid of wounded the spine and the spinal cord in the front line area in many respects depended also from the presence of a sufficient quantity of specialized therapeutic agencies, bed fund and presence of the specialists of the neurosurgeons.

In the initial period of the war when the organization of the net/system of neuro-surgical institutions on different fronts was located in the stage of formation, envelopment by this aid was insufficient. Subsequently this defect was comparatively rapidly



corrected. This illustrates reports of one of the evacuation hospitals of the Kalinin Front, which from the first days of war had an assignment to accept the specialized casualties. We give in Table 51 data from this of reports in the first 2 1/2 years of war.

From given data it is distinctly evident, as in the course of time the evacuation hospitals of front line area were freed/released from the various kinds of other wounded profiles/specialties and became specialized not only neuro-surgical, but also hospitals with the separation/section for those wounded the spine.

In the same report is clearly shown the gradual increase of surgical activity in the relation to wounded the spine and the spinal cord (Table 52).

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The effect of the character/nature of combat operations/processes, locality and season not the operability of those wounded the spine and the spinal cord very well evident based on the example of work of one of the institutions of the front line area, which passed on the main combat sectors of western direction.

Organizationally this institution underwent several stages in

which its disposition was too different with respect to the foremost line of breakage. In this report is noted the series/number of the basic combat operations/processes, which give representation about an increase in the operability or the casualties of this category.

Table 51. Frequency of the penetrating wounds of the spine (in the percentages to a total number of all entered casualties in 2 1/2 years, beginning with 1941).

(1) Период войны	Проникаю- щих ране- ний позво- ночника (2)
(3) За первый год . . . . .	21,1
» третье полугодие (4) . . . . .	28,0
» четвертое полугодие (5) . . . . .	32,2
» пятое (6) . . . . .	47,2

Key: (1). Period of war. (2). Penetrating wounds of spine. (3). In first year. (4). In third half-year. (5). In fourth half-year. (6). In fifth half-year.

Table 52.

(1) Период войны	Оперирова- мость ране- ных в по- звоночник (в процентах) (2)
(3) За первый год . . . . .	5,6
» третье полугодие (4) . . . . .	2,7
» четвертое полугодие (5) . . . . .	44,0
» пятое (6) . . . . .	23,0

Key: (1). Period of war. (2). Operability of those wounded spine (in percentages). (3). In first year. (4). In third half-year. (5). In fourth half-year. (6). For the fifth half-year.

Table 53. Frequency of the penetrating wounds of spine and surgical activity.

(1) Наименование операции	(2) Частота ранений позвоночника	(3) Опера- руе- мость
	(4) (в процентах)	
(5) Орловский период (1941) . . . . .	0,5	1,3
(6) Воронежский период (1942) . . . . .	0,9	4,0
(7) Орловско-Курский период (1943) . . . . .	0,25	5,2
(8) Форсирование водных преград (1943-1944) . . . . .	0,2	10,6
(9) Белорусская операция . . . . .	0,7	42,2
(10) Висла-Одер . . . . .	0,26	18,0
(11) Берлинская операция . . . . .	0,2	14,6

Key: (1). Designation of operation. (2). Frequency of wounds of spine. (3). Operability. (4). percentages. (5). Orul period. (6). Voronezh period. (7). Orul- Kursk period. (8). Assault crossing water obstacles. (9). Belorussian operation/process. (10). Vistula-Oder. (11). Prussian operation/process.

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Given data show the volume of operational aid by that wounded the spine and the spinal cord in the front line area in the course of military activities in the Great Patriotic War. As is evident, maximum incline is determined in 1944 in the period of Belorussian operation/process, after which the operability again descends. This incline during the Belorussian operation/process depended on the fact that at this time the specialized hospital for those wounded the

spine was advanced forward and at the beginning of operation/process was located in the army area. This made possible to operate those wounded into the spine and the spinal cord during the first days after wound. Entire flow of those wounded the spine and the spinal cord in the beginning of operation/process was headed directly for the front line basis, that also gave the considerable incline of operational activity. During the Prussian operation/process the significant part of such casualties was operated in the army area (Table 53).

Special features/peculiarities of treatment and post-operation conduct of those wounded a spine and a spinal cord in the front line area.

The more prolonged stay of front line therapeutic institutions at one place, their better arrangement/position their arrangement/position and higher technical equipment made it possible for them to considerably more widely utilize all possible diagnostic and therapeutic measures.

The experiment/experience of the entire Great Patriotic War showed that in the front line hospitals nevertheless predominated those wounded the spine and the spinal cord in the stage of infectious complication. Use/application in the surgical practice of

different antiseptics as sulfanilamides, and toward the end of the war and antibiotics made it possible for neurosurgeons to more daringly and more widely operate the wounds of spine, without fearing those attacked/advanced before the post-operation complications.

The method of reworking of the infected wounds of spine with the imposition in the significant part of the anechoic suture in the large measure they were obliged to antiseptics and antibiotics.

Special attention was turned in various kinds suppurative complications from the side of the cerebral shells of spinal cord. The correct understanding of the development of infectious process and the presence of sulfanilamides made it possible frequently to resort to the more radical methods of surgical treatment (K. P. Chikovani).

Furthermore, extensively was used the active treatment of different complications from one side of urinary tracts (cystotomy) bedsores, etc.

After the operating conduct of such casualties in the front line area was characterized by considerable activity. Under conditions of front line area was provided complex treatment of this type of casualties (with the attraction of urologist, therapist and other

specialists) that, it is doubtless, it played very large role in the acceleration of the recovery of those wounded the spine and spinal cord.

The presence of complications in those wounded the spine and the spinal cord in the front line institutions usually forced to hospitalize such casualties for the more prolonged period, which was being calculated on the average in 1-2 months. But also to this, it is doubtless, influenced both combat operations/processes and need the releases of cots in the foresight of the same. Evacuation by hospital trains or aircraft shortened the periods of the stay of such casualties in front line region and made it possible to evacuate them into the institutions of the deep rear.

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To this moment/torque the treatment of those wounded the spine and the spinal cord in many respects depended on combat and sanitary-tactical circumstances at the front when it was possible to see the effect of one or the other operation/process on the course of treatment in the specialized hospitals of all, until now, of the emitted stages and the degree or the possibility of the construction of this aid. With the transition into the internal area - depthward the country - the effect of combat circumstances completely ceased,

and casualties converted/transferred under the conditions of usual stationary treatment.

Regarding to the medical aid by that wounded the spine and the spinal cord in the area of the deep rear.

The therapeutic institutions of the deep rear for the treatment of those wounded the spine and the spinal cord were distributed by different areas of the country. In the institutions of the deep rear the casualties usually were treated prolonged period, entering them more frequently through several months after wound. This were greater partly casualties with those or others, mainly suppurative ones, complications or with the residual phenomena of the damage on spine and the contained spinal canal. During different years of war some institutions of the deep rear were on different distances from the front line area, and therefore the periods of the admission of such casualties were also they were diverse, but nevertheless later than in the institutions of front line area.

According to data of one of the rear evacuation hospitals, which worked at one and the same place during the entire war, it entered wounded into the spine: to 1 month after wound - 17.00/o, from 1 to 2 months - 31.00/o, from 2 to 3 months - 16.00/o, later than 3 months - 36.00/o.



Are very interesting the data about the character/nature of the damage of the bone framework of spine in casualties, who entered the institutions of the deep rear, according to the data of the same rear hospital (Table 54).

These data indicating that most frequently acted the casualties with the damage/defeat of the bodies of vertebrae, with entire obviousness they speak about the complexity of the wound of the bone elements/cells of spine. If we to this add still and the circumstance that the large part of these wounds was complicated various kinds of osteomyelitic processes or associated wounds of spinal cord, then will become completely clear the composition of the casualties, who are located undergoing medical treatment in the institutions of the deep rear.

According to data of the experiment of the Great Patriotic War, in the institutions of the deep rear was changed the profile/specialty of casualties both in the relation to the frequency of the wound of different divisions of spine and character/nature of the damage of spinal cord.

Based on materials of the same hospital, this was represented in the following form.

Table 54.

(1) Место ранения	(2) Тело поз- вон- ка	(3) Тело, по- перечные и ости- стые от- ростки	(4) Дуж- ки	(5) Дужки и от- ростки	(6) Остистый и попе- речный отросток	(7) Тело по- звонка и под- вздош- ные кости	(8) Паравер- тебраль- ные	(9) Не выяс- нено
(10) Процент . . . .	37,0	3,5	1,5	8,5	21,0	2,0	22,0	4,5

Key: (1). Place of wound. (2). Body of vertebra. (3). Body, cross and awned extensions. (4). Small arcs. (5). Small arcs and extensions. (6). Awned and cross extension. (7). Body of vertebra and iliac bones. (8). Paravertebral. (9). it is not explained. (10). Percentage.

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From Table 55 it appears, that in the hospitals of the deep rear predominated the casualties with the contusions of cone and horse tail. In them were observed the following neurologic violations.

Neurologic disorders... percentage.

Flaccid paralysis ... 16.0.

Spastic paralysis ... 12.0.

Flaccid paresis ... 49.5.

Spastic paresis ... 17.5.

Disorders of urination without the motor disorders ... 4.5.

Although the majority of these casualties upon entrance into the rear hospitals was located undergoing medical treatment in the hospitals of the front line area where the specialized aid was well organized, nevertheless 13.90% all of those wounded underwent operational intervention in the form of the late primary processing of wounds, sequestrectomy and laminectomies apropos of the bone changes, which squeezed spinal cord.

In the institutions of the deep rear the radicality of surgical intervention on spine and spinal cord with the bullet wounds also gradually was expanded. Under conditions of the given hospital was operated the known quantity of casualties, which in the preceding/previous stages not produce operation/process in the necessary volume.

Surgical work in the therapeutic institutions of the deep rear with the wounds of spine and spinal cord is shown data of the report of another therapeutic institution of the hospital basis of the rear

during the period of the entire Great Patriotic War. In this report there are indications that in the beginning of war those wounded the spine were treated in general-surgical type hospitals. In the beginning of 1942 in the same system is initiated the organization of neuro-surgical separation/section, and then also hospitals for those wounded the spine and the spinal cord. Operational work is represented in Table 56.

Table 55. Character/nature of the bullet damage of spinal cord and level of wound (in the percentages).

(1) Уровень ранения	(2) Характер повреждения спинного мозга			
	(3) ушиб	(4) частичное нарушение целостности	(5) сдавление	(6) анатомический перерыв
(7) Шейный отдел . . . . .	2,5	—	—	—
(8) Грудной . . . . .	14,5	5,5	—	8,0
(9) Конус и конский хвост . . . . .	56,5	7,5	5,0	1,0

Key: (1). Level of wound. (2). Character/nature of damage of spinal cord. (3). contusion. (4). partial violation of integrity. (5). compression. (6). anatomical interruption. (7). cervical division. (8). Thoracic division. (9). Cone and horse tail.

Table 56. The operability of those wounded the spine on the years of war, on the data of the therapeutic institution of the hospital basis of the rear (in the percentages).

(1) Характер оперируемости	(2) Год войны				(7) Среднее
	(3) первый	(4) второй	(5) третий	(6) четвертый	
(8) Общая оперируемость . . . . .	9,0	13,0	26,0	28,0	20,0
(9) Ламинэктомии . . . . .	8,0	10,0	11,0	30,0	14,7

Key: (1). Character/nature of operability. (2). Year of war. (3). the first. (4). the second. (5). the third. (6). the fourth. (7). Average. (8). General/common/total operability. (9). Laminectomies.

Given data very convincingly show the gradual increase of a quantity of surgical interventions both general/common/total ones and laminectomies.

It should be pointed out that laminectomies as generally surgical interventions, which were being conducted in the institutions of the deep rear, greatly sharply differ from the same of army and even front line area. Here more frequently conducted repeated operations/processes apropos of arachnoiditis, considerable phenomena of the compression of spinal cord Rubtsov changed surrounding tissues or in the presence of infection. Operations/processes in such cases most frequently carried the character/nature of reducing ones which were conducted predominantly into the postwar period and selection/analysis of which it does not enter into the problem of present work.

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Chapter VI.

OUTCOMES OF WOUNDS OF SPINE AND SPINAL CORD.

(General data).

Candidate of medical sciences, docent D. G. Gol'dberg.

In the published materials of the first world war 1914-1918 only French medical and sanitary service gives the numerals of the total direct outcomes of gun wounds of spine and spinal cord. According to these data, of 3413 taken into consideration that wounded the spine, with exception of those been killed on the field of battle and in the foremost infirmaries, recovered 479 (14o/o), in 1346 (39.4o/o) remained more or less sharply pronounced violations of the functions of spinal cord and 1588 (4o.5o/o) died. It is logical that taking into account the casualties, who was killed in the foremost stages of evacuation, the lethality of those wounded the spine in the French army in the first world war was considerably above and achieved

80.00/o and more.

Lethality. Considerably more frequently were published the numerals of total lethality with the wounds of spine and spinal cord, in the separate materials is given the analysis of lethality in the stages of medical and sanitary service. Thus, according to American data, in the rear hospitals of 220 obtained wounds of spinal cord died 176 (80.00/o); of those 376 obtained the wounds of spine (with the indirect damage of spinal cord) died 158 wounded the spine it died 334 (55.80/o).

Evidently, depending on hospital conditions and periods of further evacuation, the lethality of those wounded the spine in different authors, who worked in the similar stages of evacuation, is dissimilar.

According to the data of Kuempel, the lethality in the front line infirmaries achieved 65.00/o, according to data of Guillaut - 80.00/o.

From soviet surgeons in the first world war they cite data about the lethality of those wounded in the spine of V. L. Pokotilo (64.00/o), V. A. Oppel' (70.00/o) and V. N. Burdenko (80.00/o).



During the later military collisions with a comparatively small number of those wounded the spine should be noted M. N. Akhutin's data, according to whom in Khaikain-Gol 70.00/o river of those wounded the spine perished in the foremost stages of evacuation, of them 33.00/o - in the army area (predominantly obtained combined wounds of spine and organs/controls of chest and abdominal area) and 37.00/o - on GBA (of them about 3/4 from urosepsis). As a result of sanitary-tactical conditions and special features/peculiarities of communications all heavily casualties were detained and underwent treatment under conditions of the hospital basis of army.

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Of 30.00/o of those wounded the spine and evacuated into the deep rear absolute majority was viable with the favorable prognosis not only *quo ad vitam*, but also *quo ad valitudinem*.

The data, published by the individual foreign authors in the Second World War 1939-1945, do not present special interest, since each author individually had available the insignificant number of observations [(Poc-r) - USA; Matthes, Franz, Zimmer - Germany, etc.]. The reason for this is either the absence of the single organized neurosurgical service (Germany), or the insignificance of combat operations/processes and the absence of the information about

the foremost stages of the medical and sanitary service (USA).

Based on materials of the development of the histories of disease/sickness/illness/malady, the lethality in the Soviet army with the isolated/insulated wounds of spine composed 35.60/o, and with the combined wounds it was above.

The contradictory data about the lethality in the Great Patriotic war, given by different Soviet authors, depend on the stage of evacuation in which to them it was necessary to work, and the duration of observation (without taking into account the fate of casualties in the preceding and subsequent stages).

According to K. G. Terrian's data, the lethality of those wounded the spine and the spinal cord in MSB was equal to 12.90/o, in neuro-surgical divisions or KMPPG - 26.00/o.

One should add that for the deep rear, almost as a rule, were bound only the casualties with the syndrome of the partial violation of the conductivity of spinal cord for the reducing operations/processes and the conservative treatment, i.e., casualties in the absolute majority with the favorable quæ ad vitam prognosis.

Lethality in the large measure depended on the character/nature

of the wound of spine and severity of the damage of spinal cord.

Is noted high lethality with those penetrating in comparison with the nonpenetrating wounds of spine. Higher lethality with the wounds of thoracic division is explained by the larger frequency of the combined and accompanying wounds during the damage/tear of the thoracic division of spine.

According to the data of the neurosurgical center of Leningrad Front, the greatest lethality was observed with the perforating penetrating wounds of the spine to which corresponds the heaviest damage of spinal cord or rootlets of horse tail. Lethality noticeably descends with the blind ones and especially with the tangential penetrating wounds, achieving the minimum with the nonpenetrating wounds, to which correspond the least considerable damages of the contained spinal canal.

Cite data below about the lethality with the bullet wounds of spine depending on the severity of the damage of spinal cord or its rootlets (full/total/complete or partial violation of the conductivity of spinal cord, full/total/complete or partial interruption of rootlets of horse tail).

Above has already been underscored the effect of different

complications of traumatic, infectious and tropho-paralytic character/nature on the issues of wound, and also was indicated the role of surgical treatment in an improvement in the issues of wounds. The convincing confirmation of the value of the factors indicated is the given below summary table, comprised on the basis of the study of extensive materials of the development of the histories of disease.

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From Table 57 it is evident that lethality, independent of the level of wound, it is considerably above in the cases of those complicated, than in those uncomplicated. Surgical treatment gives the best issues, than conservative.

Under all conditions and with the wounds at different levels lethality among those operated lower than among those not operated. This position/situation cannot be explained by the fact that operation/process underwent the more easily casualties, since the law detected is spread both to the heaviest group of wounded, aggravated by different complications, and to the lighter group of uncomplicated wounds.

As already mentioned above (Chapter III), essential effect on the issue of the wound of spine and the associated damage of other

organs/controls and systems. The more other organs/controls was involved into the wound, the worse proved to be the prognosis of wound.

Effect on the issue of the wounds of spine has the wounding weapon. It is established/installed, that with the fragmentation wounds the lethality is above (33.00/o), than with the bullet ones (28.30/o).

Lethality with the bullet wounds of spine depending on the severity of the damage of spinal cord or its rootlets.

(1) Синдромы	Летальность (2) (в процентах)
(3) Синдром полного нарушения проводимости спинного мозга . . . . .	94,5
(4) Синдром частичного нарушения проводимости спинного мозга . . . . .	45,3
(5) Синдром полного перерыва конского хвоста с вовлечением в процесс конуса спинного мозга . . . . .	59,5
(6) Синдром частичного повреждения конского хвоста . . . . .	21,2

Key: (1). Syndromes. (2). Lethality (in percentages). (3). Syndrome of full/total/complete violation or conductivity of spinal cord. (4). Syndrome of partial violation or conductivity of spinal cord. (5). Syndrome of full/total/complete interruption of horse tail with implication in process of cone of spinal cord. (6). Syndrome of partial damage of horse tail.

Table 57. Lethality with the wounds of spine and spinal cord depending on presence or absence of different complications<sup>1</sup>, level of wound and conducted treatment (in the percentages).

FOOTNOTE 1. Are implied the complications of traumatic, infectious and tropho-paralytic character/nature (shock, hemorrhages, meningitis, decubitis, urological complications, etc.). ENDFOOTNOTE.

(1) Уровень ранения	(2) При наличии осложнений		(3) Без осложнений	
	(4) оперированные	(5) неоперированные	(6) оперированные	(7) неоперированные
(6) Шейный отдел . . . . .	27,4	52,0	14,9	33,7
(7) Грудной отдел . . . . .	57,5	86,5	49,9	67,8
(8) Пояснично-крестцовый отдел . . . . .	34,3	60,4	20,0	41,3
(9) Всего . . . . .	42,0	71,0	31,8	50,4

Key: (1). Level of wound. (2). In presence of complications. (3). Without complications. (4). operated. (5). not operated. (6). Neck division. (7). Thoracic division. (8). Lumbar-sacral section. (9). In all.

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The latter fact can be explained by a comparatively larger frequency of suppurative complications from the side of shells and spinal cord, that were being observed with the fragmentation wounds, partly and by the somewhat larger severity of the damage of spinal cord with the

fragmentation wounds in comparison with the bullet ones. It should be noted that the lethality of those wounded in the spine with each year of war descended. The lethality of such casualties in essence is determined by the character/nature of the damage of the contained spinal canal.

Reduction into the time of the Great Patriotic War of lethality with wounds of spine and spinal cord in comparison with the lethality in the previous wars testifies about the importance of the specialized neuro-surgical aid, which was widely incorporated in the Soviet army.

In accordance with the doctrine of Soviet military field surgery with rendering aid by that wounded the spine were observed the following positions/situations: 1) specialization and approximation/approach of the specialized aid to casualty, 2) evacuation according to the designation/purpose, 3) the line-of-communication principle of treatment.

A reduction in the lethality with each year of war is connected with an improvement in the methods of departure/attendance, treatment and, in particular, with an increase in doctors' surgical activity. Within the time of war were grown neurosurgeons' new cadres from the young doctors, who worked in the specialized hospitals under



qualified neurosurgeons' leadership/manual. Before the completion of this process of the formation of cadres the results of treatment were more badly than from the second year of war despite the fact that since 1942, simultaneously with the deployment of offensive operations and to those connected with this improvement in the conditions of carrying out/removal from the field of breakage a comparatively large number of those heavily wounded into the spine entered hospital net/system.

As showed the experiment/experience of war, post-operation lethality depends on the severity of the damage of spine and spinal cord, presence of the combined or associated wounds, general condition of casualty up to the moment/torque of operation/process, character/nature, period and volume of surgical intervention.

Different complications from the side of spine and of spinal cord, observed to the operation/process (liquorrhea, bedsores, urinary infections, wound infection), and also complications, which were being developed after operation/process, exerted a substantial influence on the issue of surgical intervention.

Finally, sizable value for the issue of wound had the stage of evacuation, in which was conducted the operation/process, opportuneness and operation/process technique, post-operation

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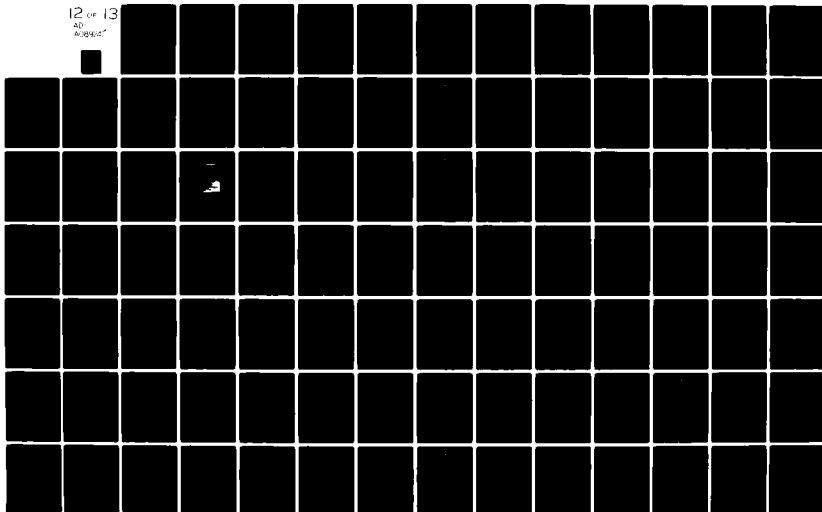
FOREIGN TECHNOLOGY DIV WRIGHT-PATTERSON AFB OH F/G 6/5  
EXPERIENCE OF SOVIET MEDICINE IN A GREAT PATRIOTIC WAR 1941-194--ETC(U)  
AUG 80 D G GOLDBERG, I Y RAZDOL'SKIY  
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departure/attendance and subsequent treatment in different stages of evacuation.

The diversity of the reasons, which are determining lethality, the more or less expanded or stenotic readings to surgical intervention explain different numerals of post-operation lethality, given by different authors.

According to N. N. Vuzednko's data (1943), post-operation lethality in the first world war comprised in average/mean 45.0-55.0o/o of those operated. In the Great Patriotic War it was equal to on the average 30.0o/o.

According to A. N. Bakulev's data (1944), of 181 that operated died 35 (19.3o/o).

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On the divisions of spine the lethality among those operated, based on materials of the personal observations of A. N. Bakulev, is distributed as follows (Table 58).

The issues of surgical treatment according to the same data are represented in Table 59.

Of those 35 operated by S. A. Rogal'skiy under conditions of GBA died 6 people.

According to the data of N. I. Grashchenkov and N. S. Chetverikov (1944), post-operation lethality among observed by them those wounded in the spine was equal to 31.60/o.

In the neuro-surgical center of Leningrad Front (1945) in those operated apropos of the penetrating wounds of spine post-operation lethality was equal to 17.40/o, although 10.00/o of those operated almost had the combined wounds of spine and organs/controls of chest or abdominal area.

Actually the lethality, connected with the operation/process, did not exceed in surgeons' majority 4.0-5.00/o. As the reason for death after operation/process served the usually progressed complications from the side of the urinary tracts and bedsores with the issue into the sepsis or intercurrent diseases through the more or less distant period after operation/process.

Cite data below about the lifetime of dead persons after operation/process, according to the data of GBF of Leningrad Front (Table 60).

Table 58. Lethality among operated those wounded the spine (in the absolute numerals).

(1) Отдел позвоночника	(2) Оперировано	(3) Из них умерло
(4) Шейный . . . . .	24	4
(5) Грудной . . . . .	62	23
(6) Поясничный . . . . .	82	7
(7) Крестцовый . . . . .	13	1
(8) Всего . . . . .	181	35

Key: (1). Division of spine. (2). It is operated. (3). From them it died. (4). Neck. (5). Thoracic. (6). Lumbar. (7). Sacral. (8). In all.

Table 59. Issues (in the absolute numerals).

(1) Полное выздоровление	(2) Значительное улучшение	(3) Улучшение	(4) Умерло	(5) Всего
6	27	113	35	181

Key: (1). Full/total/complete recovery. (2). Considerable improvement. (3). Improvement. (4). Died. (5). In all.

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Thus, in the first two weeks died only 5.00/o of those operated predominantly of spinal meningitis, ascending edema of spinal cord

with the operation/process in the neck division and pneumonia. Different complications after operations/processes, especially within the early periods, were observed frequently, but not always they led to the fatal result.

Complications after laminectomy in the early period of wound, on materials of GBF of Leningrad Front, were following:

(1) Осложнения	(2) Процент
(3) Нагноение операционной раны . . . . .	14,9
(4) Менингит . . . . .	7,6
(5) Остеомиелит . . . . .	7,2

Key: (1). Complications. (2). Percentage. (3). Festering operating wound. (4). Meningitis. (5). Osteomyelitis.

In spite of the above complications, post-operation lethality proved to be low.

General/common/total data of the issues of the treatment of the bullet wounds of spine and spinal cord with the characteristic of residual neurologic violations to the moment/torque of the completion of hospital treatment are led in Table 61.

Table 60.

(1) Продолжительность жизни после операции	(2) Процент
(3) До 2 недель . . . . .	5,0
, 1 месяца (4) . . . . .	8,1
, 2 месяцев (5) . . . . .	32,2
, 3 . . . . .	22,7
, 6 . . . . .	17,4
(6) Свыше 6 месяцев . . . . .	14,6
(7) Всего . . . . .	100,0

Key: (1). Lifetime after operation/process. (2). Percentage. (3). To 2 weeks. (4). month. (5). months. (6). It is more than 6 months. (7). In all.

Table 61. Functional issues of the wounds of spine in those survived (according to the data of the development of the histories of disease/sickness/illness/malady) (in the percentages).

(2) Характер ранения	(1) Исход											
	(3) Хороший	(4) Ограничение подвижности в месте боли в позвоночнике			(5) Монопарез	(6) Спинальный гемипарез	(7) Парапарез	(8) Монопарез	(9) Спинальный гемипарез	(10) Парапарез	(11) Трофическая язва	(12) Сочетание
(14) Непроницающие ранения . . . .	46,1	25,6	0,3	0,2	0,2	7,3	1,9	11,2	0,5	6,7	100,0	
(15) Проникающие ранения . . . . .	16,8	17,5	1,3	0,8	3,7	8,4	3,9	36,2	—	11,4	100,0	

Key: (1). Issue. (2). Character/nature of wound. (3). Good. (4). Limitation of mobility and local pains in spine. (5). Monoparesis. (6). Spinal hemiparesis. (7). Paraparesis. (8). Monoparesis. (9). Spinal hemiparesis. (10). Paraparesis. (11). Trophic ulcer. (12). Combination. (13). In all. (14). Nonpenetrating wounds. (15). Penetrating wounds.

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Given data show deep differences in the functional issues in the wounded, survived afterward nonpenetrating and penetrating wounds of spine. With the latter they are considerably worse. Are especially essential differences in the relation to of good functional issues



and issues with paraparesis. While with the nonpenetrating wounds of spine good issues were observed in 46.10/o of those survived after these wounds, with those penetrating they were observed only in 16.80/o. The issue of wound into paraparesis in those survived after the penetrating wounds was observed more than in third (36.20/o), and afterward nonpenetrating - in 11.20/o. Paraplegia in those survived after the penetrating wounds it was also observed considerably more frequently than afterward nonpenetrating.

Given data show that with the penetrating wounds of spine prediction must be very restrained not only in the relation to the survival of casualties, but also functional issue in those survived.

The limitation of mobility and local pains at the level of the wound of the spine with the penetrating wounds were observed more frequently than with the nonpenetrating ones, possibly, because the latter/last group wounded more frequently underwent radical surgery.

Representation about the clinical issues gives tables 62. The materials, given in it, relate to the penetrating and nonpenetrating wounds. In the first graph are given the issues without depending on that, were casualties operated or not and there have they any complication or it it was not; in the remaining four graphs/counts the issues were distributed depending on the factors pointed out

above.

Good functional issues were achieved in 31.50/o of those survived after wound. In essence they were obtained in the cases of paravertebral and nonpenetrating wounds.

Table 62. Clinical issues of the wounds of spine and spinal cord in those survived (in the percentages).

(1) Исход	(2) Все ранения	(3) Неоперированные и неосложненные	(4) Оперированные и неосложненные	(5) Неоперированные и осложненные	(6) Оперированные и осложненные
(7) Хороший функциональный исход	31,5	44,9	46,2	26,9	29,4
(8) Ограничение подвижности и местная болезненность позвоночника	23,3	14,3	18,0	29,5	29,8
(9) Монопарез . . . . .	0,4	0,5	0,5	0,7	0,7
(10) Гемипарез . . . . .	0,4	0,2	0,4	0,4	0,4
(11) Паралез . . . . .	2,2	0,9	0,8	0,7	2,1
(12) Монопарез . . . . .	7,3	11,3	9,0	3,6	6,0
(13) Гемипарез . . . . .	2,6	3,6	2,6	3,6	1,7
(14) Паралез . . . . .	21,6	18,4	6,4	21,1	19,6
(15) Трофические язвы . . . . .	0,4	—	0,4	—	0,5
(16) Сочетание . . . . .	10,3	5,9	15,7	13,5	9,8
(17) Всего . . . . .	100,0	100,0	100,0	100,0	100,0

Key: (1). Issue. (2). All wounds. (3). Not operated and uncomplicated. (4). Operated and uncomplicated. (5). Not operated and complicated. (6). Operated and complicated. (7). Good functional issue. (8). Limitation of mobility and local sickness of spine. (9). Monoparesis. (10). Hemiparesis. (11). Paraparesis. (12). Monoparesis. (13). Hemiparesis. (14). Paraparesis. (15). Trophic ulcers. (16). Combination. (17). In all.

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During the analysis of the subsequent graphs distinctly comes forward the dependence of good issues on the degree of the development of different complications of wound. In casualties without the

complications, regardless of the fact, were they operated or no, good results were obtained approximately/exemplarily 1 1/2 times more frequent than in those having complications. In the presence of complications somewhat better the issues were obtained in those operated (in 29.4 against 20.90/o). Given data underscore the value of the surgical processing of wounds as the method of struggle with the wound infection and warnings/prevention of its penetration into the spinal canal.

Is sufficiently high the percentage of the limitations of mobility and pains in the spine - 23.3. Attention is drawn to the fact that the violations indicated are noted almost 2 times more frequent in casualties with the complications in comparison with those not had them. Parapareses occurred into 21.60/o. The positive effect of surgical interventions and the absence of infectious complications with this form/species of issues come forward especially distinctly. While in casualties without the complications and not operated parapareses occurred into 18.40/o of cases, in the operated and also not had complications they were observed only into 6.40/o of cases, in the operated and also not had complications they were observed only into 6.40/o of cases, i.e., almost 3 times thinner/less frequent. In the presence of complications in those operated parapareses were observed somewhat thinner/less frequent than in those not operated (with respect 19.6 and 21.10/o).

Good issues in the presence of complications in those operated were also into a relatively larger number (with respect 29.4 and 26.9o/o).

Is very small the percentage of trophic ulcers - 0.4. The unhealing and relapsing/recidivism/recidivist/recidivity ulcers were observed mainly during the stable damages/defects of medullary cone and rootlets of horse tail. Ulcers in these patients appeared, as a rule, in the region of buttock folds and were supported by the traumatization of the anesthetized zone in connection with the prolonged seat at the solid chairs/stools and the benches/docks.

General/common/total issues depending on character/nature and level of the wound of spine are represented in Tables 63 and 64.

From Tables 63 and 64 it is evident that the best issues are noted in those wounded the neck and lumbar division of spine. The worse results are obtained with the penetrating wounds, than with the nonpenetrating ones. The comparison of issues with the wounds, which are escorted/tracked by the damage of spinal cord or horse tail, during different years of war is represented in Table 65.

Table 63. Issues of the penetrating wounds of spine depending on the level of wound (in the percentages).

(1) Исход (2) Отдел позвоночника	(3) Восстановление трудоспособности	(4) Ограничение трудоспособности с различной степенью инвалидности	(5) Прочие исходы
(6) Шейный . . . . .	5,9	34,0	60,1
(7) Грудной . . . . .	3,4	13,4	83,2
(8) Пояснично-крестцовый . . . . .	6,9	33,1	60,0
(9) Всего . . . . .	5,0	23,1	71,9

Key: (1). Issue. (2). Division of spine. (3). Reduction of ability to work. (4). Limitation of ability to work with different degree of disablement. (5). Other issues. (6). Neck. (7). Thoracic. (8). lumbar-sacral. (9). In all.

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In this table attention is drawn to an improvement in the functional outcomes during wounds of spine and spinal cord.

The results of the treatment of gun wounds of spine and spinal cord in the Great Patriotic War considerably were improved in comparison with the results of the treatment of such casualties in the previous wars. But the obtained favorable outcome far are not maximum. The effect of the treatment of those wounded the spine can

be considerably improved by increasing in the surgical activity, opportuneness of surgical intervention, increase in the cadres of the qualified neurosurgeons and other specialists. To this also should to contribute the timely evacuation of casualties according to the designation/purpose into the correctly organized and well equipped special hospitals or the separations/sections for the casualties into the spine and the spinal cord.

Table 64. Issues of the nonpenetrating wounds of spine depending on the level of wound (in the percentages).

(1) Исход (2) Отдел позвоночника	(3)	(4)	(5)
	Восстановление трудоспособности	Ограничение трудоспособности с различной степенью инвалидности	Прочие исходы
(6) Шейный . . . . .	41,6	49,7	8,7
(7) Грудной . . . . .	36,8	39,8	23,4
(8) Пояснично-крестцовый . . . . .	38,1	48,8	13,1
(9) Всего . . . . .	38,6	46,1	15,3

Key: (1). Issue. (2). Division of spine. (3). Restoration of ability to work. (4). Limitation of ability to work with different degree of disablement. (5). Other issues. (6). Neck. (7). Thoracic. (8).

Lumbar-sacral. (9). In all.

Table 65. Issues of the bullet wounds of spine depending on implication in the process of spinal cord on the years of war (in the percentages).

(1) Исход	(2) Характер ранения и год войны	(3) Ранения позвоночника									
		(4) с повреждением спинного мозга					(5) без повреждения спинного мозга				
		(6) первый	(7) второй	(8) третий	(9) четвертый	(10) за все годы	(6) первый	(7) второй	(8) третий	(9) четвертый	(10) за все годы
(11) Восстановление трудоспособности . . .		8,1	7,4	7,0	6,8	7,2	55,4	52,9	58,0	50,7	54,3
(12) Ограничение трудоспособности . . .		33,3	36,2	43,6	42,3	39,7	35,4	37,2	34,5	41,9	37,3
(13) Прочие исходы . . .		58,6	56,4	49,4	50,9	53,1	9,2	9,9	7,5	7,4	8,4
(14) Всего . . .		100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

Key: (1). Issue. (2). Character/nature of wound and year of war. (3). Wounds of spine. (4). with damage of spinal cord. (5). without damage of spinal cord. (6). the first. (7). the second. (8). the third. (9). the fourth. (10). in all years. (11). Reduction of ability to work. (12). Limitation of working capacity. (13). Other issues. (14). In all.



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Chapter VII.

#### CLOSED DAMAGES OF SPINE AND SPINAL CORD.

Candidate of medical sciences, docent D. G. Gol'dberg.

The closed damages of spine and spinal cord under military field conditions were encountered considerably thinner/less frequent than bullet. Based on materials the developments of the histories of disease/sickness/illness/malady, closed damages of spine and spinal cord composed 0.20/o of all combat damages of spine.

In the specialized neuro-surgical agencies where they were concentrated such the injured/damaged, closed damages of the spine were encountered considerably more frequently, achieving in GBF 8.5-8.7o/o (I. S. Babchin, 1943), in the institutions of the near rear - 3.7-3.9o/o (N. I. Grashchenkov, 1942-1943) and in the institutions of the deep rear - 7.0o/o (Z. I. Geymanovich, 1943) with respect to all neuro-surgical casualty and patients.

In the onset of the closed damages of spine and spinal cord in

field conditions it is possible to note different etiological factors. They included the avalanches by the earth/ground, the incidence/drop with the height (coservers/spotters, proofreaders, pilots, etc.), the collapse of dugouts, mud huts, reinforced-concrete pillboxes and bunkers, buildings/structures, incursions of transport, air wave with shell bursts and mines, which throws back victim frequently on the considerable distance, etc. It should be noted that, in spite of the exclusively developed motorization of army in the Great Patriotic War, nevertheless transport (switching on tanks) as the reason for the closed damages of spine under hospital conditions is noted considerably thinner/less frequent than it was possible to expect.

In the first place in the frequency stood the destructive force of artillery and mortar fire, which led to collapse and avalanches of defensive installations, by that frequently led to the damages of the spine via direct impact or by means of the air wave.

According to the data of the neuro-surgical center of Leningrad Front, in 159 cases of the closed damages of the spine the mechanism of trauma it was distributed as follows (see table on pg. 361).

The diversity of the reasons, which caused the closed damages of spine in field conditions, led to the fact that were destroyed all

divisions of spine, whereas during the closed damages of spine in peacetime of 4/5 breaks of spine, especially compression, they fall on lower-thoracic and upper-lumbar vertebrae (I. S. Babchin, A. V. Bondarchuk, V. V. Gorinetskaya et al.). However, under military conditions comparatively frequently were encountered the damages of upper-lumbar (I-II vertebra) and lower-thoracic (XI-XII vertebra) division of spine, achieving 44.20/o (GBF).

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More frequently was damaged one vertebra, but, depending on the mechanism of trauma, sometimes proved to be damaged two, three and more than vertebrae.

Among all closed damages of spine in the given material is established/installed the damage of one vertebra into 61.50/o of cases, two vertebrae - into 30.10/o, three vertebrae - into 7.50/o and more than three vertebrae - into 0.90/o of cases.

On the basis of data of autopsies L. I. Smirnov (deep rear, 1945) indicates that on the autopsy were most frequently established/installed the closed breaks of the XII of thoracic and first two lumbar vertebrae (75.00/o), about 15.00/o fell to lower-lumbar vertebrae and about 10.00/o - to the average/mean and

upper thoracic vertebrae. One should consider that these data related to the heaviest forms of the damage of spine, in all cases by the escorted/tracked damage of spinal cord. In L. I. Smirnov's material it is not noted the damages of the neck division of spine, since victims died in the quite foremost stages of evacuation; with the more mild cases of the damage of the neck division of spine the casualties achieved hospital net/system and usually they got better.

(1) Механизм повреждения	Процент (2)
(3) Завалы земель . . . . .	13,2
(4) Обналы оборонительных сооружений и различных построек . . . . .	29,2
(5) Прямые ушбы пзвизоничника при ударе . . . . .	29,2
(6) Падение при отбрасывании воздушной волны при разрывах снарядов, авиабомб и пр. . . . .	4,7
(7) Автотранспорт и танки . . . . .	11,4
(8) Падение с высоты . . . . .	12,3
(9) Всего . . . . .	100,0

Key: (1). Mechanism of damage. (2). Percentage. (3). Avalanches by earth/ground. (4). Collapse of defensive installations and different construction. (5). Straight/direct contusions of spine with shock. (6). Falling during deletion by air wave with shell bursts, aircraft bombs and so forth, etc. (7). Motor transport and tanks. (8). Incidence/drop from height. (9). In all.

(1) Уровень повреждения	(2) Частота повреждений (в процентах)
(3) I—II шейный позвонок . . . . . III—V           "                 " VI—VII          "               "	2,8 8,5 } 12,3 1,0 }
I—II грудной позвонок (4) III—X                 " XI—XII              "	2,0 25,5 } 47,4 19,9 }
I—II поясничные позвонки (5) III—V                "	24,3 } 40,3 16,0 }
(6) Всего . . . . .	100,0

Key: (1). Damage level. (2). Frequency of damage (in percentages).  
(3). neck vertebra. (4). thoracic vertebra. (5). lumbar vertebra.  
(6). In all.

Classification of the closed damages of spine and spinal cord.

The closed damages of spine and spinal cord are divided into three groups:

- 1) the breaks of spine without the violation of the function of spinal cord;
- 2) the breaks of spine, which were being escorted/tracked by the violation of the function of spinal cord;
- 3) the damage of the contained spinal canal without multiple failure of spine.

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The neurologic classification of the damages of the contained spinal canal without multiple failure of spine or with by closed the damage of the latter in no way differs from classification in the bullet wounds. Were here also observed the syndromes of the full/total/complete either partial violation of the conductivity of spinal cord or horse tail, having the consequence of the full/total/complete or partial interruption (damage) of spinal cord, compression, contusion or its jolt, hemorrhage into the spinal cord

(hematomyelia) or the snells (nematorrhaxis), etc.

The damages of spine are most completely represented into several A. V. Bondarchuk's modified classification, used at different fronts for the time of the Great Patriotic War. According to this classification, all closed damages of spine are divided into six groups:

- 1) breaks,
- 2) dislocations,
- 3) break-dislocations,
- 4) the elongation of intervertebral ligaments.
- 5) abruptions of the closing plates,
- 6) the damage of intervertebral disks.

According to the character/nature of the damage of different anatomical education of spine in accordance with the given classification they distinguish:

1. Damages of ligamentous/connecting apparatus - distortions.

2. Damages of ligamentous-joint apparatus, escorted/tracked by dislocation or by subluxation/semiluxation of spine, and with multiple failure of the intervertebral disk and by its displacement.

3. Damages of bodies of vertebrae in the form of cracks, hemorrhages and microstructural changes in them.

4. Breaks of bodies of vertebrae:

a) compression,

b) fragmented,

c) cross,

d) breakaways of closing plates (more frequently they were observed in young subjects in the form of apophysiolytic).

5. Breaks of posterior semiring of vertebrae:

a) arches,

b) joint extensions,



c) cross extensions,

d) awned extensions.

6. Break-dislocations during combination of break of spine with damage of ligamentous-joint apparatus. R 7. Combined breaks of bodies and small arcs:

a) without displacement,

b) with displacement.

8. Displacement of spine without bone damages. The latter/last group of damages was examined frequently as a break-dislocation. However, as showed the careful investigations of A. N. Novikov (1941), the relationship/ratio of the joint surfaces of vertebrae during such damages not disturbed, interarticular ligaments are retained, therefore, there is no dislocation in the actual sense of word, but the displacement of that lying of above the division of spine occurs due to the decomposition of intervertebral disk.

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The given classification covers actually entire diversity of the

encountered closed damages, although the combined damages were not contained by that given and were switched on different combinations of the break of bodies, small arcs, apophysiosis of vertebrae, and also damage of sac-ligamentous apparatus and intervertebral disk. Under hospital conditions were very frequently encountered the combinations of the fragmented break of the body of vertebra with its simultaneous compression.

In the given above material of GBF in quarter of cases (25.10/o) is noted the damage of the contained spinal canal without multiple failure of spine. Here were involved the contusions of spine, which were being escorted/tracked by nematomyelia, contusion, jolt of spinal cord, etc. In 75.00/o or cases were determined the breaks of the separate elements/cells of vertebrae in different combinations. In 6.30/o were encountered the breaks of spine without the violation of the function of spinal cord and into 68.60/o - breaks of spine, which were being escorted/tracked by the violation of the function of spinal cord.

According to the character/nature of the break of spine it was established/installed:

(1) Характер перелома	(2) Процент
(3) Компрессионный перелом тел позвонков . . . . .	58,5
(4) Оскольчатый перелом тел позвонков . . . . .	19,8
(5) Перелом-вывих . . . . .	3,3
(6) Перелом поперечных и остистых отростков . . . . .	4,2
(7) Комбинированный перелом тел дужек со смещением . . . . .	14,2
(8) Всего . . . . .	100,0

Key: (1). Character/nature of break. (2). Percentage. (3).

Compression break of bodies of vertebrae. (4). Fragmented break of bodies of vertebrae. (5). break-dislocation. (6). Break of cross and awned extensions. (7). Combined break of bodies of small arcs with displacement. (8). In all.

From the preceding information it is evident that most frequently were encountered the compression breaks of the bodies of vertebrae. One should emphasize that in this group of compression breaks frequently they were encountered and the fragmented breaks of upper-front/leading edge of the body of the damaged vertebra, as this is noted in the practice of peacetime in the cases of the compression breaks, caused by the hyper-inflexion of spine at the moment of trauma.

A comparatively insignificant number of isolated/insulated damages of awned, cross and joint extensions is explained by the fact that the victims with such moderate/mild damages frequently were

located undergoing medical treatment in the general-surgical hospitals, if the damage of spine retreated to the second plan/layout before the damages of other units of the body.

Mechanism of the damage of spine.

In the mechanism of the damage of spine, as in peacetime, it was possible to establish/install: 1) indirect damage and 2) straight/direct damage.

During the indirect damage by basic mechanism at the moment of trauma was represented hyperflexia or the hyperextension of spine in the neck or thoracic-lumbar division beyond the limits of physiological possibilities. Here should be related the incidence/drop from the height to the head, on the feet or the nates. With this mechanism of trauma more frequently were noted the compression breaks of the bodies of vertebrae with the displacement or without their displacement.

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Frequently were encountered the oblique breaks of the bodies of vertebrae with the line of break downward and from behind in advance. Smaller, upper, unit of the broken vertebra in this case were

displaced forward and downward, and larger/coarser lower fragment - toward the rear, to the side of spinal canal, squeezing more or less strongly contents of spinal canal.

The simultaneous break of bodies, joint extensions and small arcs of vertebrae during the indirect damage of spine was encountered only with the large violence, which evenly acted on the spine along its vertical axis. The breaks of the bodies of vertebrae in this case occurred in the sagittal plane (A. V. Bondarchuk).

With the incidence/drop in the victim from the large height, together with the sharply pronounced compression break of the bodies of vertebrae, was observed simultaneously the damage also of small arcs, and also the articulation of the corresponding vertebrae, in consequence of which the break was complicated by subluxation/semiluxation and considerable zigzag bending and narrowing of spinal canal. Such breaks more frequently were observed in the transient thoracic-lumbar division and in the upper lumbar vertebrae. Somewhat more rarely they were noted in lower-lumbar and neck division of spine and it is most rare in the thoracic. These breaks are noted in pilots, paracutists, observers, correctors. Rarely with the incidence/drop in the victim from the large height it was possible to observe the compression break of two vertebrae at the different levels, and also the break of the odontoid extension of the

## II neck vertebra.

With the collapse of defensive installations to the person, who was being located at the moment of trauma in the vertical position, were noted the multiple breaks of spine. In similar cases during the x-ray examination it was possible to establish/install the compression of the bodies of one-two of vertebrae and the break of the small arcs two-three or others is above or lower than arranged/located vertebrae.

During the straight/direct damage the traumatizing agent directly damaged spine. This mechanism of trauma was encountered in soldiers in obtaining by them or shock swoon, by the fragments of defensive installations or with the sharp incidence/drop on the back with the direct damage of spine. With the visit of transport are noted the straight/direct and indirect damages of spine.

During the straight/direct damage of spine more frequent it was possible to observe the breaks of the posterior semiring of spine - awned extensions, joints, small arcs (Fig. 121 and 122).

The heaviest damages of spine and spinal cord were observed with the collapse of defensive installations, stone and wooden structures to the person, who was being located at the moment of trauma in the horizontal position.

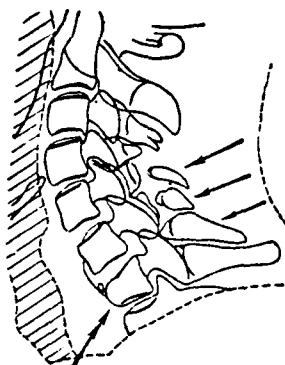


Fig. 121. The anatomical scheme of the lateral X-ray photograph of the neck division of the spine sick p. which being located in the vertical position, obtained the contusion of neck by the beam/gully of the brought down dugout. X-ray photograph is produced 4 months after trauma. During the x-ray examination is established/installed the compression break of body of the VII neck vertebra (designated by double arrow/pointer), with the full/total/complete separation/section of its insignificant front-upper sector. Calcification of the front/leading longitudinal ligament between the VI and VII neck vertebra. The corresponding division of the prevertebral blanket is somewhat expanded due to the residual infiltration of soft tissues. Furthermore, are discovered the breaks of the awned extensions of the IV, V and VI neck vertebra together with the posterior sectors of the arcs of these vertebrae (they are noted by arrows/pointers). All separated awned extensions were displaced down.

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Fig. 122. The same patient, that in Fig. 121. Impression from X-ray pictures.

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During the x-ray examination of such patients it was possible sometimes detect the full/total/complete separation of spinal column into two independent break, from which caudal proved to be displaced



toward the rear and upwards, going to the height one-one and one half of the bodies of vertebrae (Fig. 123).

This separation of spine into two independent break occurred as a result of the full/total/complete separation/section of the cranial or caudal division of the body of one vertebra together with the corresponding disk with the simultaneous break of the small arcs of this vertebra with the gap of entire ligamentous/connecting apparatus. This damage was represented clinically at first glance by the variety/subspecies of break-dislocation of spine. However, x-ray analysis showed that in such cases was usually only a break of spine with the considerable displacement of its scrap. The integrity of intervertebral joints and disk in this case was not disturbed, and therefore actual dislocation it did not occur. With such breaks from the body of the damaged vertebra was separated/liberated only the very narrow scrap, connected with the intervertebral disk. This fragment sometimes consisted only of the unit of closing plate and bone edge/boundary annulus.

In similar cases appeared actual osteoapophyseolysis of spine, if break was developed in subject with the unfinished ossification of skeleton.

The described breaks were observed in division of spine proved

to be displaced toward the rear, whereas the strains which sometimes were observed with bullet osteomyelitis of spine, were characterized by the displacement of the caudal division of spine toward the front.

The mechanisms of the closed breaks of spine indicated under combat field conditions led to the more frequent than in peacetime, and to the more massive damage of spinal cord, its shells and rootlets with the trauma.

Together with the trauma of spine, frequently were observed more or less severe damages of other organs/controls and systems, breaks of extremities, closed damages of the organs/controls of abdominal area, etc.

The closed damages of spine, obtained during the delstion of victim by the air wave of the torn shell or aircraft bomb, sometimes were escorted/tracked by the simultaneous bullet wound of other units of the body.

From given data are visible the characteristic features of mechanism and clinical manifestation of the closed damages of spine, which were being encountered in the wartime, and their difference from the analogous damages of peacetime.

Damage of the contained spinal canal.

According to the data of the specialized hospitals of GBF the closed damages of spine were escorted/tracked by the violation of the function of spinal cord into 93.70/o of cases. Even during the closed damages without the simultaneous break of the skeleton of spine (distrosphy, contusions, etc., which composed 25.10/o of all closed traumata) are noted more or less considerable changes from the side of spinal cord, its rootlets and snells.

In the mechanism of the violations of the conductivity of spinal cord and its rootlets during the closed damages of spine it was possible to note a number of factors.

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They include: 1) the straight/direct contusions of spinal cord or rootlets of horse tail, 2) damage and compression of spinal cord by bone fragments, 3) the violation of liquor circulation, 4) the violation of blood circulation, 5) the violation of lymph circulation, 6) blast effect.

1. Straight/direct contusion to spinal cord was inflicted by both shifting bone fragments or broken vertebra and bending at

moment/torque traumata of small arc of vertebra, but without their break.

The especially massive damages of spinal cord and rootlets of horse tail were observed with the breaks, which were being escorted/tracked by the considerable displacement of vertebrae. In the material of the specialized hospitals of GBF of the front of a similar form/species the damages into 3/5 cases were escorted/tracked by the syndrome of the full/total/complete violation of the conductivity of spinal cord. In a number of cases during the separation of spine into two independent segments and spinal cords together with the shells it was completely divided in two separate cuts. In the remaining 2/5 cases of straight/direct contusions occurred the contusion of spinal cord with the more or less full/total/complete reduction of the lost with the grass functions in the next 3-6 weeks after trauma or compression by the displaced bone fragments with the partial violation of the conductivity of spinal cord.

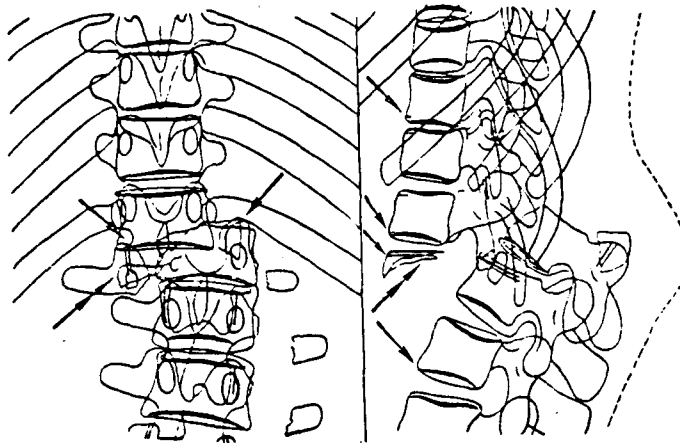


Fig. 123. Anatomical schemes from the X-ray photographs of lower-thoracic and upper-lumbar division of the spine sick n. which, being located in the horizontal position, obtained the contusion of back by the beams/gullies of the brought down dugout. During the x-ray examination is established/installed the break of the upper sector of body of the I lumbar vertebra which led to the full/total/complete separation/section of cranial closing plate together with yet not synosteotic limbic, i.e., occurred osteoapophysiolosis of its body (cranial scrap of body was shown by dual arrow/pointer). Arrows/pointers noted independent limbic of other vertebrae. Is discovered the break of the right half small arc of the XII thoracic vertebra in the region of root and interarticular unit. Furthermore, is revealed the break of the left lower joint extension of this vertebra in the region of his basis. As a result of the breaks indicated occurred the full/total/complete separation of

spinal column at the level of the I lumbar vertebra to two independent segments, from which caudal was displaced toward the rear and upwards with the setting for the cranial to the height of one vertebra. The intervertebral disk, which is located between the XII thoracic and I lumbar vertebra, remained the connected with cranial fragment of spine together with the unit of closing plate and corresponding limbus of the I lumbar vertebra. Both intervertebral joints preserved whole, in this case right joint remained in the large unit/formation with the the cranial fragment of spine, and left - with the caudal (both joints were shown by arrows/pointers).

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And during the closed damages of the spine of full/total/complete parallelism between the bone pathology and the violation of the function of spinal cord and rootlets it was not observed. Together with the massive damage of spinal cord with the undamaged/uninjured spine it was possible to meet considerable decomposition of one, two and more than vertebrae, especially in the neck division, without any noticeable violations of the conductivity of spinal cord in the presence of light radicular phenomena.

K. 4/IV 1942 during the explosion of aircraft bomb was rejected/thrown on 4-5 m to the side. To the short period lost the

consciousness. For 4 days it was located on DMP, then 11 days - in GLR, where "predominantly it lay/rested". After the admission into the neuro-surgical hospital (GBF complained about the forced position/situation of head due to the sickliness in the neck.

During the investigation up to the moment/torque of admission was determined the considerable limitation of mobility in the neck division of spine. The muscle tension of neck. Sickliness during the palpation in lower-neck division of spine. Axial load on the spine is slightly morbid with the projection of pains "into the depth of neck". Light hypesthesia with hyperpatic xanthochromia within the limits of the fifth and sixth neck segment from both sides. There is no paresis, reflector violations. In the X-ray photographs is discovered the compression break of body of the V neck vertebra with the small displacement of that or forward lying of above the division of spine. Break of small arcs and awned extensions of the IV, V and VI neck vertebra.

After two week stretching of the glisson loop of patient it was evacuated into the rear in plaster collar. On the obtained after 5 years information it works in the kolkhoz, he performs all agricultural works, remained the limitation of the mobility of neck, pain no, there are no other complaints.

Experiment/experience showed that without timely surgical intervention after any considerable compression of spinal cord it does not remain hopes for the reduction of the conductivity of the latter.

2. Damage and compression by bone fragments. With the fragmented breaks frequently was observed the damage of solid cerebral shell by bone fragments and their penetration into the substance of spinal cord with its more or less considerable damage.

L. I. Smirnov, A. A. Kulikovskaya met on the autopsies of small tear wounds of solid cerebral shell with the cross or partial softening of spinal cord. These changes were not limited to the focus of break, but were spread also in the cranial and caudal direction for certain elongation/extent, depending on severity traumata.

In the more mild cases bone fragments proved to be only in the epidural space, squeezing contents of the dural sack. But also in such cases it was possible to note the foci of softening spinal cord, caused by the contusion of the latter at the moment of trauma, and also by the compression of spinal cord with the accompanying violation of blood circulation and circulation of cerebro-spinal fluid. The same effect on the contents of the dural sack is exerted with compression fracture of the posterior edge of the body of the



broken vertebra, which was being introduced in the spinal canal. In similar cases the operational removal/distance of the compressive bone fragments or even the removal of "wedge Urbana" was represented by completely by necessary (N. N. Burdenko).

3. Violation of liquor circulation. As with the bullet wounds, the sharp/acute pressure increase of cerebro-spinal fluid, which appeared at the moment of trauma, became the supplementary factor of the damage of spinal cord not only at the level of trauma, but also on the distance. A sharp/acute pressure increase of cerebro-spinal fluid at the moment of trauma exerted influence not only on the vascular and lymphatic system of spinal cord, but also on the substance of spinal cord and its correction.

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In the sanguiferous system of spinal cord with this mechanism of damage are noted the strains of vascular walls, the education of thrombi and even gaps or vessels with the larger or smaller hemorrhages (A. A. Kulikovskaya).

4. Violation of blood circulation. The violation of blood circulation, in particular, hemorrhage, during the closed damages of spine and spinal cord played in the pathogenesis of the damage/defeat of spinal cord, it is doubtless, greater role than with the bullet wounds.

Epidural hemorrhages rarely caused the compression of spinal cord. However, as showed the observations of peacetime, such hemorrhages, not not completely which did not resolve, led to the development of connective growings and the thickening of solid cerebral shell (pachymeningitis) (M. S. Margulis, Ya. M. Pavlenskiy, A. L. Polonov).

Epidural and subdural hematomas were also the reason for sharp/acute radicular pains. A comparatively frequent complication of the closed damages of spine it was hematomyelia with the dissemination of the foci of hemorrhage predominantly in the gray substance of spinal cord with the typical neurologic clinical picture of disease. Hematomyelia it was observed both with the break of spine and without its damage.

Under conditions of the specialized hospital GBF hematomyelia it is diagnosed into 3.50/o of closed damages of spine and spinal cord and considerably more frequently it was encountered together with the syndrome of the contusion of the spinal cord with which the clinic hematomyelia in the early period was closed over with conductor violations.

Neurosurgeons' majority as neuropathologists, to the end of the war considered surgical intervention with hematomyelia useless.

Strains indicated above of vessels were complicated by late ones - 3-6 weeks after trauma - by hemorrhages, especially if victim did not observe proper mode/conductions. Vascular violations led to secondary myelomalacia with the build-up/growth of the violations of the conductivity of spinal cord. Reflector angiospasm with the closed trauma of spinal cord with the development of the ischemic necrosis

of the latter is feasible, as with the bullet wounds of spine (see Chapter I. Nonpenetrating wounds of spine).

5. Violation of lymph circulation. The violations of the normal relationships/ratios between the liquor and lymphatic system led in the early (especially sharp/acute) period after trauma to edema of spinal cord, which constituted a threat to the life of victim in the case of the trauma of the neck division of spinal cord. In other cases edema of spinal cord, as with the bullet wounds, it led to the full/total/complete violation of the conductivity of spinal cord, which was being smoothed during the first two weeks.

In the Soviet postwar literature it is not brought the clinical observations, which concern ascending edema of spinal cord with the advent of general cerebral (headaches, vomiting), tonic and focus (hangar-on) symptoms from the side of brain, although the individual cases of ascending edema during the closed damages of spinal cord were noted on the autopsies (Ye. A. Uspenskiy, T. S. Chayk).

For edema of spinal cord, besides the build-up/growth of functional fallouts, the characteristically progressive pressure increase of cerebro-spinal fluid. The extraction of fluid/liquid via cerebrospinal punctures yielded to patient certain alleviation.

## 6. Damage of spinal cord by blast.

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Deserve considerable attention the contusions of spinal cord, caused by the explosion of artillery shells and aircraft bombs at the close distance from the victims, the activity of the air wave, which was being formed around the torn shell, can be equated to the strong blow into the region of spine. It is customary to assume that the contusion phenomena can develop during the determination of man in the radius of 15-20 m of the place of shell burst, in the dependence on the bore and the destructive force of the latter/last and main trend of air wave.

The mechanism of the activity of explosion on spine and contents of spinal canal was explained differently. According to one data, the shock into the back by the force of air column is transferred to the spine through the small arcs, which cave in with the trauma forward and it is rapid resetting as a result of the known elasticity bone and the ligamentous/connecting apparatus. Spinal cord in this case obtains the dual shock: 1) by the caving in small arc (direct impact) and 2) upon the return of small arc to the initial position the spinal cord, displaced at the moment of trauma forward, obtains the supplementary shock about the front/leading wall of spinal canal

(shock/counterblow).

According to others data, the explosive force is the source of the sharp oscillations/vibrations which cerebro-spinal fluid transfers to vessels and to substance of spinal cord as to the walls of spine. According to this theory, together with the jolt, the spinal cord obtains supplementary contusion as a result of jerks/impulses of cerebro-spinal fluid at the moment of a sharp pressure increase in the sub-arachnoidal space. In this case the significant role play vascular violations and, in particular, mild hemorrhages into the spinal cord and the shells.

In one case on the autopsy of that been killed 8 hours after the trauma, obtained by it during the explosion of the shell (patient, who was being located in the vertical position, was rejected/thrown on 4 m to the side and fell to sand), A. A. Kulikovskaya found diffuse edema of the shells of spinal cord, insignificant sub-arachnoidal hemorrhage and scattered light hemorrhages in the substance of spinal cord with the integrity of spine. The same changes were discovered, also, in the brain, especially in its hanger-on division. This observation can serve as the illustration of the mechanism of the damage of spinal cord by blast and the role of vascular violations with this trauma.

The fact that the violation of the conductivity of spinal cord and its rootlets with the contusions by blast sometimes appeared through several hours after trauma, draws together this disease with hematomyelia.

In the more mild cases the appeared with the air contusion paralytic phenomena rapidly were smoothed and they were considered in this case as the jolt of spinal cord.

Through several months, and sometimes 1-2 years and more after trauma appeared other pathogenetic factors, which determined the clinical picture of disease in the late and residual period. They included: a) late and secondary bone changes in the zone of former break, b) late and secondary changes in the shells, the rootlets and the substance of spinal cord.

Are known the cases when neurologic violations attacked/advanced for the first time or they grew on in the intensity through several weeks and even months after trauma.

With the operation/process in similar cases more frequently were detected the bone fragments, which, being they were soldered by general/common/total scar with the scraps of yellow ligament, caused the compression of spinal cord or rootlets of horse-tail.

Experiment/experience showed that the consolidation of the break of spine flows/occurs/lasts very slowly, moreover initially is formed periosteal corn in the absence of intergrowth in the internal divisions of the body of vertebra.

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The x-ray examination, which shows the education of the callus, can in similar cases introduce into the fallacy, and the early load of spine presents the doubtless danger for the patient.

It is known also, that the bone fragments of the broken small arc or joints of vertebra were frequently connected only by fibrous tissue into the general/common/total conglomerate, without forming actual callus. Even with the operations/processes within the late periods, in 12-18 months and more after trauma, such bone fragments were frequently mobile/motile ones. Such mobile/motile bone fragments created conditions for the compression of spinal cord and in the late period.

In the clinic of A. L. Polenov to 79 operations/processes apropos of the closed breaks of spine in 11 cases were encountered the described late changes. On the operating table in this case it was possible to reveal/detect the cicatricial masses, which included



in the general/common/total conglomerate separate bone fragments and scraps of yellow ligament. Frequently this scar was coalesced with the external leaflet of solid cerebral shell.

The late intergrowth between the bodies of adjacent vertebrae, mainly due to the calcification of front/leading longitudinal ligament, very limited the mobility of spine. Such intergrowth between the joints of adjacent vertebrae produced late spondylarthrosis, which was being escorted/tracked not only by the limitation of mobility in the appropriate division of spine, but frequently also by stable intense radicular pains.

Reparative processes in the spinal cord, the shells and the rootlets after the closed damages of spine proceeded usually over the type of aseptic productive inflammation. This process was spread gradually from the periphery to the center, i.e., from the external divisions to the internal ones.

Thus, with the operations/processes in the early phase of process it was possible to see supramembranal changes in the form of connective growings (external pachymeningitis). With the operations/processes within the later periods or with the repeated operations/processes through the more or less considerable period in one and the same patient it was possible to meet, together with the

thickening of solid cerebral shell (hyperplastic pachymeningitis), the connective growings under the solid cerebral shell, which captured arachnoidal (arachnoiditis) and soft cerebral shell, and finally cicatricial foci in the substance of spinal cord or diffuse packing/seal of the latter (sclerous form of myelitis). Rootlets of spinal cord, soldered in in the general/common/total scar, in similar cases were the source of painful pains. Thinner/less frequent in the spinal cord in this case it was possible to note the foci of softening (myelomalacia).

Given data, which more precisely formulate the mechanism of the damage of the contained spinal canal during the closed damages of spine, determined the pathological-anatomical changes, which appeared within the early and late periods after the trauma of spine, spinal cord, its shells and rootlets.

Pathoanatomical changes during the closed damages of spine and spinal cord in no way differed from the changes, which were being observed with the bullet wounds. Their special feature/peculiarity was only the character/nature of the damage of vertebrae themselves (L. I. Smirnov).

The basic special feature/peculiarity of the closed damages was the absence of wound and or foreign bodies and, consequently, also

the associated wound infections.

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Actually/really, during the closed damages of spine and spinal cord suppurative processes in the bones, the spinal cord, its shells and rootlets were represented by exclusion.

As most characteristic pathoanatomical changes during the closed damages of spine and spinal cord it was possible to note in soft tissues in the sharp/acute and early period more or less extensive bruises and hemorrhages in the focus of direct damage, and in the spine - its different damages, given above in the classification.

Depending on the mechanism of trauma, force of the traumatizing agent, action of the latter along the vertical and horizontal axis of spine with the connection of hyper-inflexion or hyperextension of spine at the moment of trauma, and also position/situation of victim during the deposition of trauma, appeared different damages of spine, intravertebral disk and ligamentous/connecting apparatus. In this case is noted the most diverse character/nature of bone violations. By most heavy were the damages, which were being escorted/tracked by the gap of muscles, intravertebral ligaments, to the yellow ligament inclusively, and the decomposition of intravertebral disks. In

similar cases the breaks of spine were escorted/tracked by considerable displacement by its and heavy damage of spinal cord to the full/total/complete anatomical interruption.

With the described above breaks with the disagreement of scrap of spine not only spinal cord, but also its shells sometimes proved to be those completely torn with diastasis between them.

Changes in the contents of spinal canal. More frequent pathoanatomical changes in the contents of spinal canal within the early periods after trauma were evinced by more or less considerable hemorrhages into the epidural cellulose. Upon the introduction of bone fragments into the spinal canal dural sack proved to be constrained, bent along the long axis. Judging by the records, produced with the operation/process within the early periods, the pulsations of dural sack in this case, as a rule, not could be seen; during the massive compression of the bodies of vertebrae of dural sack it was by that by sometimes bayonet-like bent and that narrowed at the level of compression or constrained between the small arc and the displaced toward the rear body of vertebra (wedge Urbana). With the fragmented breaks of small arcs bone fragments proved to be introduced in the solid cerebral shell, sometimes passing through it even into the substance of spinal cord, or they were arranged/located among the rootlets of horse tail. With the operation/process or the

autopsy within the early periods after trauma, almost as a rule, it was possible to note the traces of hemorrhage under the solid or arachnoid shell. At the basis of morphological changes in the spinal cord with bruises as with the bullet wounds, lie/rest the same phenomena of primary and secondary edema (predominantly in the white substance), hemorrhages (predominantly in the gray substance and the limb zone) and focus necroses at the white and gray substance.

All these phenomena appeared as a result of not only the direct effect of the traumatizing agent on the spinal cord, but also the actions of air wave by the transmission of the shock through the skin, the muscles and the osteoligamentous apparatus of spine. To this should be added the role of liquor jerk/impulse and vascular violations, noted above.

By many researchers special importance is added to reflector spasm or paralytic condition of vessels as a result of which can appear heavy changes of the hemorrhagic or ischemic character/nature in the spinal cord (Ya. A. Uspenskiy).

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L. I. Smirnov (1946) distinguishes: 1) the primary traumatic necroses of spinal cord, which appear in the sector of direct damage

or crushing of spinal cord; 2) the secondary post-traumatic necroses which are developed as a result of the advancing/attacking after trauma disorders of blood circulation and water metabolism/exchange. Late post-traumatic softenings in the spinal cord usually are of ischemic origin.

Together with the foci of necrosis, already in the first week after trauma it was possible to note, especially during the microscopic examination, the signs of reparative and organizational processes.

Reparative processes and cleansing of cerebrospinal wound from the fission products noticeably more slowly proceeded with the undamaged/uninjured solid cerebral shell, than in the presence of defect in it.

It is virtually important that in the spinal cord where on the autopsy at first glance was a full/total/complete cross interruption, during the microscopic examination frequently were detected the undamaged/uninjured filaments and cellular elements/cells (L. I. Smirnov). Sometimes, when on the autopsy it seemed that there is only partial damage of spinal cord, on closer examination was detected its full/total/complete interruption. In similar cases primary traumatic necrosis, on the assertion of the author, was composed of the focus

of crushing of the substance of spinal cord in the place of direct damage and focus of softening or contusion origin for the remaining elongation/extent of the diameter of spinal cord.

Clinic of the closed damages of spine and spinal cord.

The clinical picture of illness was composed of the damage of spine and damage of the contained spinal canal. To this frequently was connected the traumatic shock (to 1.90/o based on materials GBF of Leningrad Front, and on the cards of forward area in the institutions of army area - to 9.40/o). One should again emphasize that in this case there is no full/total/complete parallelism between the severity of the damage of spine and the violation of the functions of spinal cord and its rootlets. Are more frequent the nevertheless massive damages of spine, especially with the displacement, they were escorted/tracked by the heavy damage of spinal cord, its rootlets and snells.

Under conditions of the specialized hospitals GBF of Leningrad Front the observed neurologic violations during the closed damages of spine and spinal cord were following.

Table.

(1) Неврологические нарушения	(2) Процент
(3) Синдром полного нарушения проводимости спинного мозга	14,4
(4) Синдром частичного нарушения проводимости спинного мозга	49,1
(5) Синдром частичного нарушения проводимости конского хвоста	23,9
(6) Травматический радикулит и менинго-радикулит	6,3
(7) Без неврологических нарушений	6,3
(8) Всего . . .	100,0

Key: (1). Neurologic violations. (2). Percentage. (3). Syndrome of full/total/complete violation of conductivity of spinal cord. (4). Syndrome of partial violation of conductivity of spinal cord. (5). Syndrome of partial violation of conductivity of horse tail. (6). Traumatic radiculitis and meningo-radiculitis. (7). Without neurologic violations. (8). In all.

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Thus, in the specialized hospitals GBF it is noted only 6.30/o of breaks of spine without the neurologic violations.

The damages of the contained spinal canal without the simultaneous break of spine more frequently were expressed in the form of the partial violation of the conductivity of spinal cord (among other things of nematomyelia) or traumatic radiculitis.



The closed damages of spine were escorted/tracked considerably more frequent by the violation of the function of spinal cord and its rootlets, than the breaks of spine in the practice of peacetime, with which neurologic violations were discovered only into 44.00/o (I. S. Babchin).

Diagnosis, as with the bullet wounds, it was based on the surgical, neurologic, roentgenological and laboratory method of investigation.

Subjectively large usually complained about the pain in the region of damage, about the absence of movements in the extremities and the violation of sensitivity.

With the inspection of victim frequently it was possible to establish swelling (hematoma) at the level of damage. If patient was capable was capable to be moved, was noted the forced position/situation and the limitation of mobility, and sometimes both bending of the corresponding division of spine and also muscle tension spins or necks, in the dependence on damage level. Frequently in contrast to the bullet wounds it was possible to see prominence toward the rear (gibbus) of the aimed extension, damaged or which

lies above vertebra. During the palpation, as with the axial load, was always noted reinforcing or pain at the level of damage.

A precise establishment of presence and character/nature of the damage of spine helped only x-ray examination.

For the establishment of the character/nature of damage as the presence of the compression of spinal cord, together with neurologic investigation, as showed experiment/experience, very important value had the liquorodynamic tests/samples of Kvækkenshtadt and Stukkey and also cytological investigation of the cerebro-spinal fluid, obtained by lumbar puncture extremally from damage level. To establish the frequency of the encountered blockade of subarachnoidal space, and also the laws governing the changes in the cerebro-spinal fluid is impossible, since cerebrospinal punctures, unfortunately, were conducted far not by all victims with closed damages of spine and spinal cord.

From the histories of disease/sickness/illness/malady, obtained from the hospitals of different fronts it is apparent that with the puncture during the first 2-5 days after trauma cerebro-spinal fluid frequently proved to be the painted blood. Only in the single cases of punctures in the first week were encountered indications of the presence of the blockade of sub-arachnoidal space. With the puncture

the blockade more frequently was revealed/detected in the late period of trauma (in 2-3 months). When was detected blockade, almost as a rule, followed operational intervention.

Primary diagnosis, establishing the damage of spine and spinal cord, without the refinement of the character/nature (but sometimes also of level) of damage is possible and necessary for the therapeutic institutions or army area. In the army area it is necessary also to diagnose accompanying damages of skeleton, soft tissues or cavitory organs/controls, frequently combine with the break of spine. To refine diagnosis and to establish the character/nature of treatment is possible only in the specialized agencies of army or front line area.

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In clinical coursing with closed breaks of spine with the damage of spinal cord or its roots were observed the same complications from the side of trophic system (pedsoreas, edemas), urinary system, respiratory tract and other systems as with the bullet wounds.

With the breaks of spine with the violation of the function of spinal cord, according to materials GBF, into 47.80/o was noted the violation of urination, which was complicated by cystitis and

pyelonephritis into 21.70/o (with respect to all victims). Bladder fistula was superimposed into 18.30/o of all damages, which were being escorted/tracked by the delay of urine. Bedsores were observed into 15.00/o of such damages, pneumonia - into 15.0 o/o.

During the damages of the contained spinal canal without multiple failure of spine indicated complications were minimal: slight delay of urination, which did not give essential complications subsequently, it was noted into 10.00/o, bedsores - into 2.50/o and pneumonia - in 7.50/

With the breaks of spine without the violation of the function of spinal cord from the complications indicated were observed only pneumonia into 2.50/o of cases.

Departure/attendance and treatment.

Victims with the closed damages of spine and spinal cord needed the same departure/attendance as casualties with the bullet wound of spine. Diet, care of skin, prophylaxis and treatment of bedsores, complications from the side of the urinary system, pulmonary complications, contractures remained the same as with the bullet wounds of the spine (see Chapter IV and V).

Specific for the closed damages of spine is the evacuation technique of such victims and their arrangement in the bed after the admission into the hospital.

Taking into account that during the closed damages of spine comparatively frequently was observed the displacement in the appropriate division of spine, that suffered in the Great Patriotic War they evacuated into the army or front rear with the necessary immobilization of spine with Kramel splints, by gypsum casts or even in the gypsum bedspread, as this occurred in the central, Bolkhov, Karelian and series/number of other fronts.

Even under the difficult sanitary-tactical conditions of such victims they evacuated on the rigid panel (or on the stretchers of the construction/design of A. S. Orlovskiy) with reclination cylinder under the damaged division of spine, especially if there was a damage of a lower-thoracic or lumbar division of spine. In the army area for this purpose frequently put to use the pack/roll of overcoat either the pack/roll of linen or bundle the straw, the hay, etc. During the damage of the neck division of spine neck and head of the victim was immobilized by gypsum either carton collar or by wire splints (Fig. 67).

A. S. Orlovskiy during the evacuation of such victims from KhPPG

of the second line laid on the period of evacuation stretching by Glisson's modified loop. For the stretching he utilized a special attachment in the head rest on panel- stretchers of his construction/design (Fig. 68).

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After the admission of victim in his specialized hospital they placed to the rigid bed. Under the damaged sector of spine in the thoracic and lumbar division they laid reclamation cushion; was simultaneously conducted stretching by straps for the armpits. In all hospitals during the closed damages of spine they put to use for the therapeutic targets stretching. During the damages in the lumbar and lower- thoracic division of spine the stretching was conducted by straps for the armpits. In the absence of their special straps replaced by the convoluted sheet with the laid layer cotton in the subaxillary region. Head end the beds in this case raised on 40-60 cm; straps fixed/recorded to the head end the beds.

Counterthrust by the cargoes through the block/module/unit at the foot end of the bed, judging based on materials of the development of the histories or disease/sickness/illness/malady, was applied only in the rare institutions. During the damages of the neck division of spine under hospital conditions usually they resorted to

the stretching with glisson loop. Stretching, depending on the stage of evacuation, sanitary-tactical conditions and severity of the damage of spine, it was continued more frequently to 4-8 weeks. The skeletal/skeleton stretching, which was being propagandized by V. D. Chaklin and Z. V. Bazilevskoy with the breaks of a breast bone-lumbar division of spine, and also A. L. Polanov and his pupils with the breaks of the neck division of spine, during the Great Patriotic War did not find wide acceptance.

One should emphasize that those receiving the closed damages of spine as needing prolonged hospital treatment, almost as a rule, guided into the deep rear where then they most frequently operated from the appropriate readings (see below). In the therapeutic institutions of army and front line area usually left only victims with the moderate/mild damages of spine and of spinal cord, that were requiring according to the character/nature the traumata the brief treatment, or the nontransportable ones and prognostically (quo ad vitam) hopeless. The treatment of victims with the mild cases of the damage of spine (distortion, light contusions, breaks of extensions, traumatic radiculites), depending on a sanitary-tactical circumstances, was finished in the hospitals of front line, army, and in the series/number of the cases and army area (DMP, KhPPG of the first line).

The conducted treatment depended on the character/nature of damage.

1. Damage of spine without violation of function of spinal cord or its rootlets. During such damages in accordance with the experiment/experience or peacetime in the predominant number of cases was applied the described above stretching, moreover was used extensively functional treatment in the form of the therapeutic exercise.

Exercises proposed in essence the reinforcement of the muscles of back, loin, pelvic belt/zone and, thus, the creation of the "muscular corset", which ensures the normal static and dynamic functions of spine.

The experiment/experience of the Great Patriotic War confirmed the high advisability of the functional methods of treatment in combination with the stretching, especially with the compression breaks of spine in a lower-thoracic and lumbar division of spine. Bed mode/conditions in this case was observed during 10-12 weeks, and hospital treatment - to 16-20 weeks. Under the favorable conditions of patient they discharged without the corset.



Patients with the residual phenomena in the form of local pains and with the considerable limitation the mobilities of spine, and with the insufficiently developed musculature also supplied with detachable orthopedic corset to 1-2 years, i.e., to the reliable consolidation of break. Before the extraction of patient was obtained the instruction about the systematic continuation of special exercises. In this case in patient to 6 months it was forbidden to sit, especially in the soft armchairs, it should have been slept on the rigid bed, which does not allow/assume the sagging of back. Latter/last instructions, as a rule, patients willingly fulfilled, since they felt themselves better with the sleep on the rigid bed. Individual surgeons and neurosurgeons put to use with the uncomplicated compression breaks in a breast bone-lumbar division of spine the one-time reposition of break with the subsequent functional method of treatment. Wide acceptance in the practice of hospitals this method did not receive as the methods of skeletal/skeleton stretching.

With the breaks of the neck division of spine without the neurologic violations after stretching with glisson loop by patient, as a rule, was laid gypsum (is thinner/less frequent carton) collar which up to the moment/torque the extractions replaced by the

orthopedic headset, which reliably ensures the immobilization of the neck division of spine. This orthopedic collar, depending on the character/nature of damage, patients carried to 1-2 years after trauma.

With distortions without the noticeable bone pathology to patient was assigned the stretching to 2-3 weeks in combination with the therapeutic exercise and the massage.

With the isolated/insulated breaks of averted and cross extensions in the hospitals usually was conducted conservative treatment (rest, physiotherapy).

With the stable pains, especially with the breaks of the averted extensions of lower-neck and upper- thoracic vertebrae, which impede carrying the clothing and the equipments, free (and mobile/motile) bone fragments drove out operationally, almost as a rule, with the favorable outcome.

2. Damage of spinal cord or its rootlets without break of spine. With of this type damages, taking into account the impossibility to remove those observing in this case change (jolt, edema, bloating, hemorrhage, contusion foci) operationally, almost as a rule, conducted the conservative treatment: initially rest, then from the

3-5th day after the trauma massage, therapeutic exercise, physiotherapy, which in the favorable cases were sufficient for the possible of the character/nature damage of the reduction of functions.

However, one should consider that in a number of cases the bone changes roentgenologically could not be established. In the doubtful cases, especially during the build-up/growth of neurologic violations, the series/number of neurosurgeons not without the bases resorted to laminectomy. At the same time sometimes were driven out the bone fragments of the damaged small arc or joints, which squeezed spinal cord.

3. Multiple failure of spine and spinal cord or its rootlets. Some surgeons and traumatologists with the breaks of spine in combination with the damage/defect of spinal cord recommended the conservative methods of treatment, applying stretching, massage, passive, and on the possibility and the active exercises for the paracic muscles and a good care.

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This conservatism was based on the representation, that the emergent with the trauma damages of spinal cord cannot be removed

operationally. Only some operated with the fragmented break of small arcs with the expressed picture the compressions of spinal cord. Casualties with the closed damages of spine, especially if they were escorted/tracked by the damage of the bones of pelvis, extremities, edges/fins, etc., they frequently guided into the general-surgical hospitals. Experiment/experience showed that the operations/processes on the spine in such hospitals were conducted relatively thinner/less frequent than in the specialized neuro-surgical hospitals or the separations/sections.

Although within the time of the Great Patriotic War the surgical activity during the closed damages of spine was noticeably lower than with the bullet wounds, nevertheless operability apropos of the breaks of spine, which were being escorted/tracked by neurologic violations, grew/rose with each year of war, after achieving toward the end of war 15.20/o.

It should be noted that the operations/processes during the closed damages of spine were conducted predominantly in the rear neuro-surgical institutions. Readings to the surgical treatment of the closed damages of spine and spinal cord, developed by Soviet neurosurgeons in the practice of peacetime, completely justified themselves, also, during the Great Patriotic War.

Readings before operation. a) First of all were subject to surgical treatment the closed damages of spine with the clinical picture of the sharp/acute development of the syndrome of the compression of spinal cord or roots of horse tail.

The compression of spinal cord was clinically expressed by the build-up/growth of paralytic phenomena or pains. Frequently in this case roentgenologically it was possible to determine narrowing the lumen of spinal canal as a result of the displacement of spine or presence of bone fragments in the spinal canal. Essential aid diagnosis the compressions of spinal cord exerted the liquorodynamic tests/samples Stukkey and Avekkersstedt, and also clinical investigation of the fluid/liquid, obtained with the lumbar puncture (it is caudal from the level of break).

When the compression of spinal cord is present, the cerebro-spinal fluid frequently proved to be xanthochromium, cerebrospinal pressure by that lowered/reduced. Liquorodynamic tests/samples frequently indicated the presence of full/total/complete or partial block/module/unit.

The sharply appearing picture of the compression of spinal cord more frequently was observed during the damage of the posterior segments of vertebrae, in particular, small arcs and joint extensions

of vertebrae, but this compression was encountered also with the compression break of the bodies of vertebrae with the introduction of the posterior wall of the body of vertebra, which usually lies down from damage level, into the spinal canal.

The considerable displacement of spine was frequently escorted/tracked by full/total/complete crushing of the contained spinal canal.

The weakly developed toward the end was proved to be chapter about the introduction of the massed with the trauma intravertebral disk into the spinal canal. If bone changes in this case were insufficiently distinctly expressed, then the diagnosis of the compression of spinal cord by the choniral masses of intravertebral disk presented considerable difficulties, especially in the early period of trauma. In the late period the diagnosis was facilitated by the possibility of applying the contrast methods of study (iodolipol. Sengosin).

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b) As showed experiment/experience, with the syndrome of the partial damage of spinal cord or rootlets of horse tail, even in such cases when bone changes by the usual receptions/procedures of

experiment are not revealed/detected, should be recognized as that substantiated surgical intervention with the revision of the contained spinal canal. In similar cases was frequently determined the compression of spinal cord by fine/small bone fragments, scraps of yellow ligament, together with hematoma in the early period or its traces in the form of Ruytsovs of education in the intermediate and late period of trauma.

c) In the doubtful cases, even with the syndrome of the full/total/complete violation of the conductivity of spinal cord, neurosurgeons' majority did not reject the attempt operationally to render possible assistance victim.

Basis for this judgment is the fact that also in the early period is until recently represented the unresolved problems about what symptoms of the fallout of the function of spinal cord or its rootlets arose due to the damage or contusion and what due to their compression.

1) Sometimes as reading to surgical intervention served the sharply pronounced pains as a result of the stimulation of rootlets, especially in the region of horse tail.

e) Besides the sharply emergent compression, appeared the late

compressions of spinal cord or rootlets of horse tail by the callus, shifted bone fragment, especially in connection with the tunicary changes (arachnoiditis, external pachymeningitis, etc.), with which is shown surgical intervention.

In such cases via neurologic investigations were determined not only the cessation of the reduction of functions, but also the build-up/growth of functional railouts from the side of spinal cord and its rootlets or the irritation of the latter (pain, violation of trophic system, etc.). Liquorodynamic tests/samples in this case revealed/detected the full/total/complete or partial blockade of sub-arachnoidal space. Conservative treatment in the form of different physical therapy procedures in this case either yielded temporary/time alleviation or it proved to be completely unsuccessful. The experiment/experience of peacetime, especially after the Great Patriotic War, the experiment/experience of hospitals on the recuperation of the invalids of the Great Patriotic War, it in particular, showed all advantages of surgical intervention in similar cases (S. I. Zdrilyuk).

During the determination or the period of intervention it is necessary to be guided by the known principle: arisen as a result of the compression of spinal cord or its rootlets the removed symptoms can become nonremovable during the prolonged compression. This



position/situation acquires special importance in the cases of the sharply emergent compression at the moment of trauma. Surgical intervention was urgent during the damage of the neck division of spine with ascending edema of spinal cord. According to the later investigations of M. A. Postolov (1949), the compression of spinal cord, which was being continued is more than two weeks, it led to the irreversible changes in the spinal cord. Under clinical conditions are noted the cases of reducing the function of spinal cord after the elimination of compression and through the large periods [from several months (A. V. Bakulev) and even to 2-3 years (N. N. Burlenko, A. L. Polenov)], but such observations should be examined only as exclusion.

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As contraindication to intervention in the early periods it can serve:

1) the heavy general condition of victim in connection with the damage of other divisions or skeleton, organs/controls and systems, in particular, the organs/controls of chest and abdominal area, or in connection with far visited complications of a trophic-paralytic (bedsores, cystopyelonephritis) or infectious (pneumonia, sepsis) character/nature;

2) the absence of X-ray photographs. In the cases of the onset of the syndrome of sharp/acute compression, especially in the neck division of spinal cord, one should operate even in the absence of the possibility to produce roentgenological examination/inspection:

3) sanitary-tactical conditions, which excluded the possibility of the hospitalization of victim, at least to two weeks after operation/process.

Laminectomy technique during the closed damages of spine to a little differs from that described earlier for the bullet wounds. As a result of the frequent compression of spinal cord by mobile/motile bone fragments any supplementary pressure by the cheeks of the bone ones of forceps can prove to be disastrous for the sectors of spinal cord, which preserved potential capability for the reduction of conductivity.

If it is necessary to remove the posterior edge of the body of the vertebra, which exerts pressure on the spinal cord (wedge Urbana), those most sparing and, consequently, also advisable is transdural access (V. N. Burdenko). After the autopsy of solid cerebral shell spinal cord by flexible spatula they displace to the

side. Then they cut front/leading wall of dural sack above the bone wedge, which protrudes into the spinal canal. Bone wedge they bite bent by bone ones by forceps or will scrape by U-shaped chisel.

For the purpose of sparing spinal cord during its displacement for the access to the front/leading wall of spinal canal sometimes it was necessary to sacrifice one-two posterior rootlets after intersection of which the displacement of spinal cord considerably was facilitated.

Operating wounds during the Great Patriotic War, as a rule, sewed by the tightly four-row suture (thin silk to the solid cerebral shell, the catgut or the silk to the muscles and the aponeurosis, silk to the skin).

Anesthetization. In the absolute majority of the cases (about 4/5 operations/processes) within the time of the Great Patriotic War was applied local infiltration anesthesia. In the cases of the breaks of the neck division of spine innalation anesthesia should be recognized categorically contrasted, since the phase of anesthetic excitation can prove to be fatal for the patient in connection with the supplementary displacement of bone fragments in the spinal canal.

Skin sutures were removed/taken usually on the 9-10th day.

According to the findings, operating wounds healed into 92.50/o by primary tension, into 7.50/o was observed the surface festering, which required the removal/taking two to four of sutures.

In the single cases in the histories of disease/sickness/illness/malady were encountered the indications of the need of disclosing/expanding the wound for the purpose of the emptying of festering hematoma.

Post-operation care and treatment essentially did not differ from the same with the bullet wounds of spine.

Therapeutic exercise and massage of extremities in all hospitals conducted usually from the 5-7th day after operation/process or after the removal/taking of sutures.

In the absence of massive paralyses by patients she was permitted to get up 4-6 weeks after operation/process. Individual neurosurgeons solved early getting up (through 2 weeks) in the absence of any considerable violations from the side of nervous system. More frequent the incline of patient was determined by the dynamics of the reverse development of paralytic phenomena.

## Issues.

The issues of the closed damages of spine and spinal cord depended on the severity of the damage of spine and in an even larger measure from the severity of the damage of the contained spinal canal, and also from the character/nature of treatment.

According to the data of the neuro-surgical center of Leningrad Front, with the breaks of spine with the violation of the function of spinal cord conservative treatment, stretching, reclamation in combination with the functional treatment, the therapeutic exercise gave the following results (Table 06).

Thus, the full/total/complete reduction of ability to work with the breaks of spine with the violation of the function of spinal cord is noted only into 0.90/c, and together with the insignificant limitation of the ability to work in all into 16.90/o with 20.20/c of lethal outcomes.

The breaks of spine without the damage of spinal cord and damage of spinal cord without multiple failure of spine as a whole were considerably more the lungs, than breaks with multiple failure of

nervous system.

Lethal outcomes with them, based on materials of the same hospitals GBF, it was not observed with a considerable number (about third) of the full/total/complete reduction of ability to work.

In given data it is possible to see only nearest issues. However, taking into account that patients with the syndrome of full/total/complete violation the conductivities of spinal cord, with rare exception, did not evacuate into the rear, the numerals of lethality should be recognized close ones to the final ones. The best results are obtained during the damage of the neck and lumbar- sacral division of spine, worse - during the damage of thoracic and especially lower- thoracic division.

The surgical treatment of the closed damages of spine, as noted above, it was conducted predominantly in the therapeutic institutions of the deep rear. With the familiarization with the histories of disease/sickness/illness/malady it turned out that in the separate hospitals during such damages it was conducted too few operations/processes, and to summarize for generalizing them impossibly, taking into account the diversity of the forms of damages, periods and surgical interventions technique.

Table 66. Issues of the closed damages of spine and spinal cord with the conservative methods of treatment (GBF) (in the percentages).

(1) Характер повреждения	(2) Восстановление трудоспособности	(3) Умеренное ограничение трудоспособности	(4) Значительное ограничение трудоспособности	(5) Смерть	(6) Всего
(7) Переломы позвоночника без нарушения функции нервной системы . . . .	18,2	63,6	18,2	—	100,0
(8) Переломы с нарушением функции спинного мозга . . . .	0,9	16,0	62,9	20,2	100,0
(9) Повреждение содержимого позвоночного канала без повреждения позвоночника . . . . .	39,5	40,0	20,5	—	100,0

Key: (1). Character/nature of damage. (2). Reduction of ability to work. (3). Moderate limitation of ability to work. (4). Considerable limitation of work capacity. (5). Death. (6). In all. (7). Breaks of spine without violation of function of nervous system. (8). Breaks with violation of function of spinal cord. (9). Damage of contained spinal canal without damage of spine.

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On the same reason in medical reports of fronts and armies the treatment of the closed damages of spine did not find sufficiently complete reflection.

Therefore are given below the issues of the surgical treatment of the closed damages of spine with the violation of the function of

spinal cord according to the data of Leningrad neuro-surgical institute, quantitatively sufficient for the statistical analysis (A. V. Boidarchuk). Into this institution, which was being located in the front line area, entered chiefly the casualties with the heavy violations of the conductivity of spinal cord or horse tail.

The best issues were observed with surgical intervention to one month after trauma, although in a number of cases were obtained the favorable outcome, also, with intervention in the later periods, mainly due to the elimination of the late compression of spinal cord and violation of liquor circulation as a result of hyperplastic changes in the solid and arachnoid shell.

Spondylofixation in connection with the stable pains in the spine in hospital system it was not applied.

The comparison of issues during the conservative and surgical treatment of the closed damages of spine is difficult, since in each group could prove to be patients with the various forms of the damage of spine and contained spinal canal.

However, the experiment/experience of the Great Patriotic War and post-war time (work in the hospitals for the recuperation of the invalids of patriotic war and in the number of scientific research



neuro-surgical institutions) makes it possible to recognize the advantages of surgical treatment in early periods (first 2 weeks).

As basis for this conclusion serves the series/number of positions/situations.

1. During prolonged compression of spinal cord (it is more than 15 days, according to M. P. Postolov) violation of conductivity of spinal cord, connected with reactive edema and its secondary ischemia, can become irreversible in connection with education of secondary foci of necrosis or softening, which is spread on diameter of spinal cord.

2. Even well carried out X-ray photographs frequently leave place for doubts in relation to determination of details of occurred break, in particular, presence of bone fragments (fine/small) in spinal canal.

3. At contemporary standard of knowledge hardly ever neurologic investigation makes it possible to establish nature of violation of conductivity of spinal cord, especially in early period after trauma (damage, contusion, compression, hemorrhage, etc.).

Table

(1) Иссло	(2) Процент
(3) Восстановление трудоспособности . . . . .	0,0
(4) Умеренное ограничение трудоспособности . . . . .	28,9
(5) Значительное ограничение трудоспособности . . . . .	65,3
(6) Смерть . . . . .	5,8
(7) Всего . . . . .	100,0

Key: (1). Issue. (2). Percentage. (3). Reduction of ability to work.  
 (4). Moderate limitation of ability to work. (5). Considerable  
 limitation of ability to work. (6). Death. (7). In all.

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Being guided by the given positions/situations, neurosurgeon will more frequently operate, taking into account a comparative safety of laminectomy, for the purpose of explanation (in the doubtful cases) and possible elimination of the reasons for the violation of the conductivity of spinal cord or rootlets of horse tail.

The study of the distant results of treatment explained that from the evacuated patients with the closed damages of spine and the violation of the function of spinal cord in the rear hospitals it underwent surgical treatment 12.50/o.

The reason for death with the breaks of spine were the same complications, as with the bullet wounds with the violation of the function of spinal cord or horse tail. To them it relates shock, urological complications, bedsores, sepsis, pneumonia.

With the breaks of spine without the violation of the function of spinal cord, based on materials of the protocols of autopsies, as the reason for death usually served the associated damages of other vital organs/controls.

Lifetime among the dead persons with the breaks of spine, which were being escorted/tracked by the violation of the function of spinal cord, is small: third died in the first week, it is more frequent during the first 2 days; third lived to the month and only third vein/strand to 3-6 months and as exclusion more.

The discharged from the series/numbers armies in connection with the damage of spine, almost as a rule, being found on the clinic observation, as showed the study of the distant results, is continued treatment in the civil/civilian institutions for the place of residence, in the necessary cases obtaining also health resort treatment.

From a number of demobilized soldiers, that sent response/answer to the form I sent in connection with the closed damage of spine (putting to use the conservative method of treatment), about the half it works on the lightened work, 8.00% of patients through 3 more years were located undergoing medical treatment in the hospitals on the recuperation of the invalids of the Great Patriotic War. From the remaining invalids of the Great Patriotic War of this group the unit was returned to its work and only small unit completely does not work.

In conclusion should be noted the advisability of larger surgical activity already in the specialized hospitals of army, and by the fact of more front line area during the treatment of the closed breaks of spine, which were being escorted/tracked by the violation of the function of spinal cord in accordance with the given it is above readings to the surgical treatment of the latter.

This is attained with the necessary and full/total/complete liberation/excision in the specialized hospitals of separations/sections for the bullet wounds and the damages of spine and spinal cord.

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Chapter VIII.

Orthopedic treatment of the consequences of bullet wounds and damages of spine and spinal cord.

Corresponding member of the Academy of medical Sciences of the USSR Honored Scientist professor N. N. Priorov and the doctor of medical sciences B. V. Rubenstein.

Bullet wounds and damages of spine and spinal cord are frequently escorted/tracked by the heavy violations of the functions of extremities - paresis and paralyzes with the subsequent development of the limitation of the mobility of joints, contractures and other strains, especially from the side of feed (pes varus, valgus, equinus, equino-varus, etc.).

Questions of the orthopedic treatment of the consequences of damages of spine and spinal cord are not yet sufficiently

illuminated. Meanwhile orthopedic aid while the correct organization and the conducting considerably contributed to an improvement in the function of the damaged extremities in this contingent of casualties.

The large experiment/experience, acquired by Soviet surgeons and orthopedists in peacetime, was used for the correction of the deformations of the supporting-motor apparatus, connected with the bullet wounds and the damages of spinal cord.

For the purpose of the reduction of motor functions was applied the method of reducing the muscular equilibrium by tendinous-muscular transplantation, i.e., the transplantation of tendons and muscles.

Won acceptance and intervention on the skeleton - arthrodeses, osteotomy and resections.

Special interest are of the observations, which concern orthopedic treatment of heavy spastic contractures on the soil of bullet wounds and damages of spinal cord. Were established/installed and taken into consideration the special features/peculiarities of the procedure of the conservative and surgical treatment of such contractures.

But orthopedist-surgical measures on the muscles, the joints and

the bones hardly ever proved to be effective. Therefore were employed operations/processes on the animal and sympathetic system and on the contents of spinal canal (K. A. Grigorovich, S. I. Zdrilyuk et al.).

In the beginning of the postwar period Soviet orthopedists and surgeons began to develop/process the methods of the instruction in walking of patients with the damages/defects of spinal cord and to construct the appropriate apparatuses and prostheses.

Patients usually struck to the orthopedist already after in the preceding/previous stages was exhausted entire arsenal of neuro-surgical measures.

Orthopedic-surgical measures depended on the degree of the deformations, which were being expressed from the lung pes equinus (horse foot) or the sagging hand (manus pendula), also, to full/total/complete paralyses of one, two, and frequently also three extremities.

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As the bloodless operations/processes were applied line-of-communication redressment with the subsequent fixation by gypsum bandage. From the operations/processes on the soft tissues

were conducted tenotomy, elongation of tendons, tendectomy (with the spastic contractures), tenodesis, transplantation of tendons and muscles sub-spinal myotomy, fasciotomy.

Bone operations/processes were reduced to the osteotomy, the resection of joints, arthrolysis and arthrodesis as to operations/processes by that stabilizing. At the basis of the combined treatment lay/rested a strict sequence of operational receptions/procedures.

Line-of-communication redressment was the basic method of treatment.

The first stage was conducted under overall anesthesia/narcosis for achievement of the maximum weakening of muscles. Frequently already in this first stage it was possible to decrease the angle of contracture on 15-30°. This position of extremities was detented with circular gypsum bandage. The subsequent stages were conducted through each of 8-10 days. For this gypsum bandage they separated by circular section/cut at the level of joint. On the convex side of section/cut from the gypsum bandage they cut all over wedge, as a result of which the bandage was divided into two cases (upwards and down from the joint). Further redressment was conducted already without anesthesia/narcosis, for which the lying/horizontal below division



was utilized as the lever. The criterion of the limit of elongation were the pains about which the patient immediately notified of doctor. Subsequently usual fixation by gypsum annulus - "stage", which fastens both gypsum cases.

In separate patients came the moment, when extremity, after achieving the specific angle of flexure, did not yield to further redressment. This depended on changes from the side: 1) tendinous-muscular apparatus, 2) bundle-joint apparatus even 3) central nervous system (spastic contractures). In these patients the correction of contractures was achieved by different orthopedic interventions, in the dependence on localization and degree of paralytic contracture.

Orthopedic treatment of flaccid paralyses and contractures of lower extremities.

Paralytic deformations in a region of talocrural joint.

Patients entered orthopedic hospitals with the complaints of the impossibility of walking as a result of the sharp sagging feet (horse foot) or, on the contrary, due to the heel position/situation feet (heel foot).

As a result of prolonged abnormal load occurred abrupt changes in the skeleton of feet, it accepted the fixed/recorded position/situation of equino-varus it acquired the special features/peculiarities, characteristic for inveterate congenital talipes.

We observed 22 patients with the paralytic deformations of feet.

Are distinguished five basic forms of the deformation:

1) the sagging foot (horse foot) without noticeable changes in the bones;

2) the sagging foot (horse foot) without the bone changes, but escorting/tracking by contracture of fingers/pins and by hook-like banding of the thumb;

3) pes equino-varus without the noticeable bone pathology;

4) pes equino-varus, that is escorted/tracked by change from the side of skeleton of feet;

5) heel foot.

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During the treatment of the patients of the first group was applied one-time redressment of foot and tenotomy (elongation) of achilles of tendon. Was conducted open tenotomy of achilles of tendon or elongation by its route/path of dissection in the frontal plane. The open method facilitates observation of the possible elongation of the wrinkled neurovascular bundle with the sharp bottom inflexion. Full/total/complete correction deformation with closed tenotomy can impede frequently well expressed tendon a plantaris - it it can prove to be intact with the closed operation/process. In certain cases the elimination of deformation impeded the changed fascial strands and the posterior wall of joint capsule - them usually cut under the check views.

With the very heavy degrees of horse foot they avoided the elimination of deformation via one-time redressment. Safer had such patients to establish/install after operation/process foot to the light degree of equinus, having completely removed it through 8-10 days upon the exchange of bandage.

B-v, 32 years. In 1944 was obtained the tangential penetrating wound of spine at the level of the IV lumbar vertebra with the partial damage of horse tail. Patient entered into the

traumatological institute of the name Vrenden with the residual phenomena of the damage of horse tail in the form of full/total/complete paralysis of right foot from the sharply pronounced by deformation in the form horse foot at an angle of 140° without the noticeable bone pathology.

10/XI 1945 is produced open tenotomy of achilles of tendon by dissection in the frontal plane the elongation of well expressed tendon a plantaris and the dissection of fascial strands. Moan it is established/installed in the position/situation of the lung pes equinus and it is fixed by gypsum bandage. Through 8 by it upon the exchange of bandage - mid-position. Prolonged immobilization (1 1/2 months) for achievement of rigidity. After the removal/distance of gypsum - stable mid-position of foot. Orthopedic foot-wear with strong "tibias" allowed patient to throw crutches.

In 3 months of complaint of the difficulty of walking as a result of the "hook-like" thumb. After operation/process - the angular-figurative osteotomy of basic phalanx of foot of the thumb and its installation in the moderate back inflexion - the bending is completely removed.

Should be emphasized the need for prolonged immobilization.

V. D. Chaklin during the elimination of stable deformations of the type of horse foot resorted to tenodesis. For this stabilization he utilized tendons of the paralyzed extensors of foot - a tibialis anterior and a extensor digitorum communis longus. After preliminary tenotomy of achilles of tendon and correction of contracture he crossed/intersected the tendons of these muscles in the place of their transition into the muscle and were conducted the ends of these tendons through two cross canals, drilled into the tibia on the boundary of middle and lower third of shin one towards another, and it joined by their loop. Thus, the tenodesized tendons were converted into the similarity of the durable ligaments, which well stabilize foot.

The intensive load on the external edge of foot in a number of cases led to abrupt changes in the skeleton of foot, to heavy that fixed/recorded equino-varus. These bone changes were the unsurmountable obstacle to the elimination of deformations via the described above methods. In such cases applied crescent-shaped resection of foot or supramalleolus osteotomy of bones of foot. Readings to the first operation/process were placed with the heavy degrees of supination and reduction, to the second - with the lungs, but the insurmountable for the bloodless correction degrees of paralytic equino-varus.

K-v, 28 years. In 1944 was obtained the fragmentation wound of spine with the damage of spinal cord in the region of horse tail. After the admission - full/total/complete paralysis.

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Blurred, but fixed/recorded equino-varus. Clinically and roentgenologically - bone deformation. Repeated line-of-communication redressment also of tenotomy of achilles of the tendon not of the distance of success.

8/I 1947 was produced supramalleolus osteotomy of the bones of shin. Because of the angular-figurative section it was possible to derive foot to the position/situation of the moderate hyper-correction and to avoid common for this method bayonet-like deviation of the lower end of crus.

As a result of the partial damage of rootlets of horse tail either jack damage/defeat of the front/leading crescents of spinal cord in the region of lumbar thickening were observed stable paralyzes of separate muscles or muscular groups, which led to the violation of muscular equilibrium (synergists and antagonists) and to the secondary deformation; with this more frequently were observed the contractures of the type pes equino-varus or the heel foot. If

the first were the consequence of the fallout of the motor functions of muscles, pronating the foot (mainly m peroneus and m extensor digitorum communis), then at the basis of the second lay/rested the fallout of the functions of muscles, which fold foot (in basic m triceps surae and the flexors of fingers/pins).

Similar damages/defeats made it necessary to go by means of reducing the muscular equilibrium - tendinous-muscular transplantation, utilizing a vast experiment/experience of peacetime.

During the deformations of the type equino-varus, taking into account that the basic reason for contracture is the tibial group of muscles, for the purpose of the reduction of muscular equilibrium grafted/transplanted to the external edge of foot of tendon m tibialis anticus or posticus.

The transplantation of tendons during the paralytic deformations indicated, which was being conducted taking into account the condition of the healthy/sound and paralyzed muscles, as a rule, led to the correction of form and function of extremity. After transplantation assigned the carrying of orthopedic foot-wear with the elevation of external edge of foot.

In separate patients were employed the stabilizing

operations/processes. One of them is arthrolysis, artificial bone abutment, that amends deformation and leaving working volume of movements in the joint. With the the paralytic equinus and with the retention/preservation/maintaining of the function of gastrocnemius muscle and flexors of the fingers/pins of tenotomy of achilles of tendon in a number of cases frees patient from the relapse, from the return of faulty position/situation. In these patients was applied posterior arthrolysis of talocrural joint. Operation/process consisted in the fact that two transplants - autotransplant and heterotransplant - after tenotomy of achilles of tendon and installation of foot in the mid-position drove in in the bias through the collision bone into the heel so that the free ends of the transplants would be abutted against the posterior surface of the lower pineal system of the tibia, impeding return of foot to position/situation pes equinus.

With the the paralytic equinus was applied also posterior arthrolysis according to G. I. Turner. By the chisel of beater the plate of heel bone with the fastened to it achilles tendon; the bone plate, bent back upwards, established at the level of upper edge its separations/sections from the heel bone, preventing thus relapse equinus.

With the paralytic foot of heel was obtained stable effect,



applying arthrolysis. The bone nail, undertaken from the comb of the tibia, drive in in talus with the bottom inflexion of foot at an angle of  $110^{\circ}$ . The projecting from talus free end of the nail, being abutted against the front face of the lower pineal system of the tibia, prevented the relapse of heel foot.

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With full/total/complete bilateral paralysis in the region of the talocrural joint, when bilateral arthrodesis was completely undesirable, patients they supplied different types with foot-wear with the supporting attachment - with the elastic elastic or with the steel spring.

Motor violations and paralytic deformations in the region of knee joint.

As the consequences of the wounds of spinal cord were observed motor disorders in the region of knee joint.

Paralyses or paresis of the extensors of shin, as a rule, lead to the bending contractures of the knee joint of different degree.

When the bending contracture of knee joint is present, the

treatment is begun always from line-of-communication redressment according to the given above method. As a rule, the contracture of the knee joint of average/mean severity completely was amended into 3-5 stages. After course the physiotherapy (massage, hydropathy) by patient assigned orthopedic splint to the knee joint for 6 months. In the heavy cases it was necessary to be solved to surgical orthopedic interventions. One of them was the open elongation of the tendons of all three flexors - mm. bicipitis femoris, semitendinosus and semimembranosus. Not always and after this it was possible to achieve full/total/complete correction. Then through 2-3 weeks produced one or two supplementary redressment.

K-a, 25 years. In 1944 it is wounded. Blind-end fragmentation wound of the thoracic division of spine with the damage of spinal cord. Full/total/complete paralysis of the lower extremities. Are disrupted the functions of pelvic organs/controls. After the admission in 1946 was established/installed full/total/complete paralysis of the extensor of right shin. The function of flexors is satisfactory. Bending contracture at an angle of 145°. Sagging foot - full/total/complete paralysis of muscles.

During April 1946 four "stages" of redressment. During June of the same year the elongation of the tendons of all three flexors. Contracture is corrected completely. Simultaneously tenotomy of

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achilles tendon for weakening equinus. After the supply with orthopedic foot-wear with the nose/leading edge under the heel of patient it threw crutches, change to the stick.

Experiment/experience showed that sometimes the considerable obstruction exerts wrinkled tractus ilio-tibialis, which in such cases it was necessary to cut in lower third of thigh into entire its width. This proved to be especially useful with the paralytic bending contracture of hip joint.

With the instability of knee joint sometimes can be set a question about the reduction of muscular equilibrium via transplantation m bicipitis femoris and m semitendinosus.

Motor disorders in a region of hip joint.

Motor disorders in the region of hip joint during the damages/defects of spinal cord were either partial and then they were expressed in the contractures of different intensity, in essence of bending ones, or they were observed in the form of full/total/complete paralyzes of muscles, which act in the region of hip joint, which lead to the paralytic dislocation.

With the bending contractures, which deprived the patients of

the possibility to put to use extremity, basic obstruction were the dense strands of the strained muscles, which begin from spina ilii anterior superior. The surgical treatment of these contractures began from line-of-communication redressment according to the rules/handspikes, described above.

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But hardly ever this bloodless line-of-communication treatment proved to be successful, since there was sharp resistance of the abbreviated/reduced muscles, which was explained with subsequent bloody interventions. In some patients it was necessary to resort to the dissection of wide fascia of thigh and m sartorius.

During resistance of the wrinkled fascial strands applied correction the contractures with the aid of the tightening osteotomy of thigh. Contracture with certain shortening of extremity completely was amended.

High value for the statics has at least the partial retention/preservation/maintaining of the function of buttock muscles; therefore it is very expedient to go by means of the substitution of the lost function of buttock muscles.

In the case of paralysis of buttock muscles after the wound of spinal cord for the substitution of the function of buttock muscles is utilized by a sacrospinalis and wide fascia of thigh. From the fascia cuts out itself the band and it is prepared to the level of large trochanter. Is uncovered fastening a sacrospinalis, is intercepted/detached tendinous unit and muscle for the known elongation/extent it will be mobilized. The graft/flap of wide fascia is conducted sub-periosteal through the lower edge of large trochanter, then its end they conduct by the forceps through entire buttock region under the skin, introduce through the aperture on the spin and they connect with the tendinous unit of a sacrospinalis. A similar stabilization of hip joint can have the expanded readings, if one considers that with the bullet wounds of spinal cord rarely was observed the damage/defeat of the function of back muscles.

With full/total/complete flaccid paralyzes of both lower extremities of large it has the capability to stand and to be moved with the aid of the crutches. In this case is developed the peculiar gait in which take large part back muscles. Gypsum bandage creates the similarity of arthrodesis of hip and knee joint and makes it possible with the aid of the back muscles to control extremities. After the instruction of patient in walking in the gypsum bandage were assigned orthopedic apparatuses with half-jacket, with the locks in the joints and orthopedic foot-wear. In such apparatuses of

patient first it was moved on the crutches, and then with the bacillus/rod. Locks made it possible to sit with the bent feet.

Orthopedic-surgical treatment of flaccid paralyses of upper extremities.

Paralyses of upper extremities on the soil of the bullet wounds of spine with the damage of spinal cord were encountered comparatively rarely.

Usually these disorders were expressed in paralysis of the groups of muscles, which unbend hand, which lead to the "sagging hand" (manus pendula). In one patient it is analogous with the procedure, used with paralysis of radial nerve, were produced the transplantation of tendons a flexor carpi radialis and a flexor carpi ulnaris to the extensors of hand, the made possible of the active straightening of hand. In one patient was produced arthrodesis of radiocarpal joint (removal/taking cartilages from the joint surfaces of the bones of forearm, first and second series/number of the bones of wrist and attachment by the heterotransplant, carried out in the bias through the joint in the bone of the wrist). By this operation/process was achieved not only cosmetic, but also functional effect.

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For the purpose of the functional stabilization of hand in the advantageous position/situation with paralysis of the extensors of hand is designed lightened type splint (splint "Extensor"), which consists of the light rubber band, which is fixed at the extremal end of the forearm, and springs, resting in the volar surface of hand; spring sets hand in the position/situation of straightening, without counteracting the active inflexion of hand (D. N. Fedorov).

But especially complex for orthopedic-surgical treatment are full/total/complete paralyzes of the entire upper extremity, which hangs helplessly as lash. V. D. Chaklin performed arthrodesis of shoulder and elbow joint, assigning orthopedic apparatus for the retention of the paralyzed hand. It is possible to manage, also, without this apparatus, applying simultaneously with these two arthrodases of tenodesis of radiocarpal joint (Table 67).

Special features/peculiarities of orthopedic-surgical treatment of spastic paralyzes and paresis of lower extremities.

Beginning to orthopedic-surgical treatment of spastic paralyzes and paresis of lower extremities, which develop after wounds and damages of spinal cord, it was necessary to consider the special



inclination of spastic contractures to the firm relapses. It should be noted that similar patients in the first period wars underwent lasting treatment in usual type evacuation hospitals or in the specialized neuro-surgical hospitals.

Observations of 12 cases of the spastic contractures of lower and upper extremities in the traumatological institute and the hospitals of Leningrad testify about the possibility of orthopedic-surgical treatment of such patients, gloomy to the heavy disablement.

With redressment in such patients it is necessary to consider first of all the possibility of the development of clonic spasms. Similar spasms caused the strong morbid perceptions, which sometimes made it necessary to drive out gypsum bandage and to cease treatment.

Therefore during the treatment of these patients frequently they rejected the elongation of tendons with their subsequent cross-linking and produced myoectomy and tendectomy, cutting as far as possible large sectors of the spastically strained tendons and muscles, maximally separating the ends of the muscles, which participate in shaping of contracture. The ends of the tendons and muscles usually are soldered between themselves by scars. But these scars proved to be sufficiently long and created least favorable

conditions for the development of the relapse of contracture.

The spastic contractures of talocrural joint were removed via closed tenotomy of achilles tendon without the subsequent hyper-correction to avoid the development of spastic heel foot.

With the spastic bending contracture most favorable results are obtained with tendectomy of the tendons of all flexors of shin.

Basic obstruction to the elimination of the spastic bending contractures of hip joint were those strained, as the ropes: 1) the muscles, which begin from spinae ilii anterior superior: ■ tensor fasciae latae and ■ sartorius, 2) ■ rectus femoris and finally 3) ■ ileopsoas. Myoectomy of the first two muscles it was conducted according to the method which was given above, just as cut-off ■ sartorius.

Sometimes with the heavy irremediable spastic contractures of hip joint was conducted tightening high osteotomy of thigh. The contractures of the bringing muscles were removed as during the disease/sickness/illness/malady of Little, either via subcutaneous myotomy in the place of their fastening to the pubic bone or with the aid of the operation/process - neurectomy.

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Table 67. Results of operational correction of the deformations of extremities on the soil of flaccid paralyses and paresis after the bullet wounds of spinal cord and spine (according to the data of the traumatologic institute and civil/civilian hospitals of Leningrad). Period of the observation of 1-3 years.

(1) Характер деформации	(2) Количество наблюдений	(3) Характер оперативного вмешательства	(4) Результаты			(8) Примечание
			(5) хорошие	(6) удовлетворительные	(7) неудовлетворительные	
(9) Отвислая стопа (pes equinus) без костной патологии	4	(10) Тенотомия ахиллова сухожилия (открытая) и сухожилия m. plantaris после предварительной редрессации	4	—	—	(11) У одного из больных в последующем — углообразная остеотомия основной фаланги большого пальца
(12) То же	4	(13) Задний артролиз ауто- и гетеротрансплантатом (после предварительной редрессации контрактуры)	3	—	1*	(14) * Трансплантат сломался вследствие ранней нагрузки — рецидив
(15) Паралитическая косолапость (pes equino-varus) без костной патологии	3	(16) Редрессация контрактуры с последующей пересадкой на наружный край стопы сухожилия m. tibialis antici и ушиванием сухожильный лям. regonaeorum	2	1*	—	(17) * Пережатое сухожилие оторвалось от места прикрепления; стопа в среднем положении. Активная функция отсутствует
(18) Паралитическая косолапость, сопровождающаяся изменением скелета стопы	3	(19) Серповидная резекция по Куслику	3	—	2*	(20) * Причина неуспеха — недостаточность иссечения костного «серпа». В обоих случаях — рецидив
(22) То же	4	(21) Подлодыжечная остеотомия	4	—	—	—

(22) Птичья стопа (pes equinus)	2	(23) Артродез голеностопного сустава и передний артролиз стопы	1	—	1*	(24) После артролиза — полный рецидив в связи с переломом трансплантата, введенного в таранную кость
(25) Сгибательная контрактура коленного сустава	3	(26) Пересадка сухожилий mm. bicipitis femoris и semiten- dinosi на надколенную после предварительной этапной ре- дрессации	3	—	—	(27) Полное активное разгибание в коленном суставе
(12) То же	1	(28) Метаплазия по Вредену	1	—	—	—
(29) Полный паралич в области коленного сустава (разболтан- ный сустав)	1	(30) Артродез коленного сустава	1	—	—	—
(31) Сгибательная контрактура тазобедренного сустава	3	(32) Субспинальная миотомия m. tensor fasciae latae и m. sartorius	2	—	1	—
(12) То же	1	(33) Подвертельная остеотомия	1	—	—	—
(34) Ограниченная кисть	1	(35) Пересадка на тыл кисти су- хожилий mm. flexor carpi radialis и ulnaris	1	—	—	—
(36) Итого . . .	32		26	1	5	

Key: (1). Character/nature of deformation. (2). Number of observations. (3). Character/nature of operational intervention. (4). Results. (5). good. (6). satisfactory. (7). unsatisfactory. (8). Note. (9). Sagging foot (pes equinus) without bone pathology. (10). Tenotomy of achilles tendon (open) and tendon a plantaris after preliminary redressment. (11). In one of patients subsequently - angular-figurative osteotomy of basic phalanx of thumb. (12). The same. (13). Posterior arthrolysis auto- and by heterotransplant (after preliminary redressment of contracture). (14). Transplant was

broken as a result of early load - relapse. (15). Paralytic talipes (pes equino-varus) without bone pathology. (16). Redressment of contracture with subsequent transplantation to external edge of foot of tendon m tibialis antici and sewing of tendons mm. peroneorum. (17). Grafted/transplanted tendon was detached away from moan's place of fastening; in mid-position. Active function is absent. (18). Paralytic talipes, which is escorted/tracked by change in skeleton of foot. (19). Crescent-shaped resection according to Kuslik. (20). Reason for failure - deficiency of carving of bone "sickle". In both cases - relapse. (21). supramalleolus osteotomy. (22). Heel foot (pes calcaneus). (23). Arthrodesis of talocrural joint and front/leading arthrolysis of foot. (24). After arthrolysis - full/total/complete relapse in connection with break of transplant, introduced into collision bone. (25). Bending contracture of knee joint. (26). Transplantation of tendons mm. bicipitis femoris and semitendinosi on knee cap after preliminary line-of-communication redressment. (27). Full/total/complete active straightening in knee joint. (28). Metaplasia according to Vreden. (29). Full/total/complete paralysis in region of knee joint (stirred joint). (30). Arthrodesis of knee joint. (31). Bending contracture of hip joint. (32). Sub-spinal myotomy m tensor fasciae latae and m sartorius. (33). Tightening osteotomy. (34). Sagging hand. (35). Transplantation to rear of bone of tendons mm. flexor carpi radialis and ulnaris. (36). Altogether.

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Table 68. Results of combined operational correction of spastic contractures on the soil of the bullet wounds of spine and spinal cord (according to the data of traumatological institute and civil/civilian hospital of Leningrad). Period of observation from 6 months to 2 years.

(1) Характер контрактуры	(2) Количество наблюдений	(3) Характер оперативного вмешательства	(4) Результаты			(8) Примечание
			(5) хорошие	(6) удовлетворительно	(7) не удовлетворительно	
(9) Тяжелые сгибательные контрактуры тазобедренных и коленных суставов	4	(10) Этапные редрессации. Суб-спинальная миотомия m. tensor fasciae latae и m. sartorius и миотомия m. rectus femoris и m. psoas с обеих сторон	3	—	1	
(11) Множественные контрактуры всех суставов нижних и верхних конечностей	1	(12) Этапные редрессации контрактур нижних конечностей	—	—	1	(13) Вследствие постоянных судорог и трения кожи под гипсовыми повязками образование множественных пролежней. Летальный исход
(14) Множественные контрактуры трех суставов обеих нижних конечностей	1	(15) Этапные редрессации всех трех суставов: тендотомия всех трех сгибателей с обеих сторон, подвздошная остеотомия справа	1	—	—	(16) Больной, ранее пригавший на следенных нижних конечностях, встал на ноги и в настоящее время ходит с палочкой
(17) Сгибательные контрактуры обоих коленных суставов	3	(18) Тендотомия всех трех сгибателей с обеих сторон с последующей редрессацией вследствие невозможности полного разгибания после операции	2	—	1	(19) Ресидия контрактуры стопы в связи с недостаточным сроком обучения больного ходьбе после операции

(20) Спазмическая (spasmodic) контрактура голеностопного сустава на почве спастического гемипареза	1	(21) Тенотомия (открытая) ахиллова сухожилия	-	-	1	(22) Рецидив контрактуры
(23) Спазмическая сгибательная контрактура левой кисти (гемипарез)	1	(24) Отсечение рудеросии в лучезапястном суставе и тенотомия сухожилий m. flexor carpi radialis и ulnaris palmaris, артродез лучезапястного сустава	1	-	-	-
(25) Спазмическая сгибательная контрактура правого лучезапястного сустава (гемипарез)	1	(26) Удлинение сухожилий сгибателей кисти и пальцев	1	-	-	-
(27) Итого...	12					

Key: (1). Character/nature of contracture. (2). Number of observations. (3). Character/nature of surgical intervention. (4). Results. (5). good. (6). satisfactory. (7). unsatisfactory. (8). Note. (9). Heavy bending contractures of hip and knee joints. (10). Line-of-communication redressment. Sub-spinal myotomy & tensor fasciae latae and & sartorius and myotomy & rectus femoris and & Neopsoas from both sides. (11). Multiple contractures of all joints of lower and upper extremities. (12). Line-of-communication redressment of contractures of lower extremities. (13). As a result of permanent spasms and friction of skin under gypsum bandages education of multiple bedsores. Lethal outcome. (14). Multiple contractures of three joints of both lower extremities. (15).

Line-of-communication redressment of all three joints; tendectomy of all three flexors from both sides, tightening osteotomy to the right. (16). Patient, previously jumped on brought lower extremities, stood up to feet and at present he walks with a cane. (17). Bending contractures of both knee joints. (18). Tendectomy of all three flexors from both sides with subsequent redressment as a result of impossibility of full/total/complete straightening after operation/process. (19). Relapse of contracture of foot in connection with insufficient period of instruction of patient in walking after operation/process. (20). Spastic (equinus) contracture of talocrural joint on soil of spastic hemiparesis. (21). tenotomy ( open) of achilles tendon. (22). Relapse of contracture. (23). Spastic bending contracture of left hand (hemiparesis). (24). Line-of-communication redressment in radiocarpal joint and tendectomy of tendons m. flexor carpi radialis and ulnaris palmaris, arthrodesis of radiocarpal joint. (25). Spastic bending contracture of right radiocarpal joint (hemiparesis). (26). Elongation of tendons of flexors of hand and fingers/pins. (27). Altogether.

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As an example of the combined surgical treatment of the multiple heavy spastic contractures of lower extremities after the damage of spinal cord can serve the following observation.



K., 27 years, during August 1941 obtained the partial damage of spinal cord in breast division, after which developed paralysis of lower extremities with the full/total/complete disorder of sensitivity and function of pelvic organs/controls. Subsequently remained the heavy spastic contractures of hip and knee joints, to three years which riveted patient to the bed. Only toward the end of 1944 of patient it began to be moved with the aid of the hands.

After the admission were discovered spastic contractures in the hip and knee joints at sharp angle.

During the year to patient were produced the following operations/processes:

1. Line-of-communication cautious redressment under narcosis of knee and hip joints. During the first stage it was possible to bring the contractures of right extremity to the right angle in the hip and knee joint, the left hip joint - to 145 and knee - to 155°. Subsequent redressment were conducted without anesthesia/narcosis.

2. Tightening osteotomy of right thigh.

3. Tendectomy of all three flexors of left shin.

4. Tendectomy of flexors of right shin.

Toward the end of 1945 after the supply with orthopedic foot-wear with the correction of the shortening of the right extremity of patient it began to walk with the aid of the bacillus/rod.

In all this sick intervention they were hindered/hampered due to the clonic spasms, which were being developed immediately after line-of-communication redressment.

To the success of treatment several contributed the active exercises of patients themselves and the extensively used physiotherapy and therapeutic physical culture.

During the war sometimes with spastic paraplegia of lower extremities (spastic contracture of knee joints) was conducted arthrodesis of knee joint, on one hand, and epicondylic osteotomy - on the other hand.

However, taking into account the exceptional diversity of damages/defects, in each individual case necessary is careful

analysis for the purpose of selecting of the most effective methods of treatment. With the heavy spastic contractures, together with the orthopedic measures on the tendons, the muscles and the joints, they resorted to interventions on the animal and sympathetic nervous system and first of all on the damaged division of spine and the contents of spinal canal (I. M. Grigorovskiy, S. I. Zdrilyuk et al.).

From the point of view of the effectiveness of treatment on the basis of a similar analysis deserves attention the observation of T. S. Zatsapin and Kh. M. Freydin, that concerns casualty, who suffered spastic paresis of both lower extremities with the inclination to the spasms after the bullet fragmentation wound of the thoracic division of spine and spinal cord in 1944. To initially casualty was produced laminectomy with the removal/distance of foreign body and the bilateral sympathectomy of the II, III and IV lumbar ganglion/node, considerably lowered the intensity of spastic phenomena. But the report/event of walking proved to be impossible: the spastic hyperextension of bottom from its detent into the floor/sax caused "shielding" reactions - the flexure of extremities in all three joints. These "bicycle" movements were finished to the heavy spasms. One of the links of pathological reflector circuit was switched off via orthopedic operation/process - the step-like open elongation of tendon ■ extensor hallucis longus. As a result Babinski's symptom disappeared. Through 2 weeks of patient already it could stand on the

feet without the reflector phenomena indicated.

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With the bending bilateral contractures of radiocarpal joint (hook-like hand) patients, in spite of a good function in the elbow and shoulder joints, they prove to be helpless and they cannot service/maintain themselves. In such cases was applied line-of-communication redressment in the radiocarpal joint and tendectomy of the tendons of flexors (a flexor carpi radialis, a flexor carpi ulnaris and a palmaris). Thus it was possible to derive hand to the mid-position, after fastening result by arthrodesis of radiocarpal joint. In certain cases of tendectomy was substituted by the maximum elongation of the tendons of the flexors of fingers/pins using the method Epstein-Rozov. As a result the hand stops to the known degree functionally useful.

Within the time of the Great Patriotic War Soviet orthopedists utilized entire their experiment/experience in the specially orthopedic aid by that wounded the spinal cord. Nevertheless one should recognize that remain still numerous questions, connected with the utilization of achievements of plastic surgery, orthopedic operational technology and orthopaedic supply for rendering aid to the invalids of the Great Patriotic War after the bullet wounds of spine and spinal cord.

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Conclusion.

Real member of the Academy of medical Sciences of the USSR the honored worker of science professor A. N. Bakuleye.

In the first the world and preceding it wars a question about the bullet wounds of spine and spinal cord was not developed/processed as the individual chapter (section) of military field surgery. Scarce works on this question, although the very valuable, were not systematized and they were based usually on the small material of personal observations. Somewhat larger illumination this question acquired during the war with the White Finns 1939-1940, when were refined some questions of the therapeutic and of organizational character/nature, connected with the bullet wounds of spine and spinal cord.

Only during the years of the Great Patriotic War by the works of the Soviet neurosurgeons, neuropathologists and surgeons the problem of the bullet wound of spine and spinal cord was set sufficiently widely and to a considerable degree obtained its permission.

The principal theoretical and practical results of the experiment/experience of the Great Patriotic War with respect to bullet wounds of spine and spinal cord are the following.

The existed previously point of view to the bullet wounds of spine and spinal cord as for the hopeless in the sense treatments also of issues must be rejected. Already during the first year of war as a result of the thorough and intensified study these wounds by the overwhelming majority of the neurosurgeons and neuropathologists began to be considered as being subject, similar to other wounds, urgent and active surgical treatment. Important role in this respect played also the organization of the ordered specialized neuro-surgical aid in the system of the military medical service of Soviet army, completely not preceded not into one of the previous wars. It ensured the possibility to concentrate casualties, who obtained the bullet wounds of spine and spinal cord, in the specialized therapeutic agencies and lightened both the organization of treatment and care of casualties and study of wound itself. It made it possible to also conduct training the qualified cadres of the neurosurgeons, neuropathologists and roentgenologists for the treatment of these casualties.

The wounds of spine and spinal cord have a series/number of clinical and pathoanatomical special features/peculiarities, which

completely substantiated the independent existence of the section of the bullet wounds of spine and spinal cord.

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The difficulties of the recognition of character/nature and degree of the damage/defeat of spine and spinal cord by doctors not by specialists under conditions of the foremost stages of evacuation with the temporary stay of there wounded conditioned the need for creating the single classification of surgical and neurologic violations and their complications which had to contribute to the refinement of diagnosis before these wounded into rear institutions under observation more experimental and qualified specialists' admission. Large help in the recognition of character/nature and degree of damage was the manufactured during the Great Patriotic War clinical X-ray classification of the bullet wounds of spine and spinal cord, based on the detailed comparison of clinical picture and relationships/ratios of wound canal and canal of spine. This comparison gave the possibility to establish degree and character/nature of the damage of the substance of spinal cord, its shells and rootlets.

The practice of work in the Great Patriotic War required the review of the very concept of the penetrating wound of spine. The for

the first time introduced into the period of the first world war concept of the penetrating wound of spine required so that would be compulsorily established/installed the damage of solid cerebral shell. But the experiment/experience of the Great Patriotic War showed that the establishment of the violation of the integrity of solid cerebral shell, with exception of a small number of cases, possibly only on the operation/process or on the autopsy.

Experiment/experience at the same time showed that the character/nature and the severity of the damage of spinal cord, the danger of the development of severe suppurative complications in its substance, and in the cerebral shells are also located the intimate dependence not only on the damage of solid cerebral shell, but also on that, is opened or opened by the wounding shell the lumen of spinal canal. However, the permission of this question in the majority of cases provided the surgical analysis of wound and the X-ray analysis of spine.

Therefore it turned out that it is virtually useful to carry to the penetrating wounds of spine all its those wounds, with which occurs the autopsy of spinal canal. This determination of the penetrating wound of spine introduced much clarity into the organizational measures and surgical tactics of the doctors of all stages of sanitary evacuation and, in particular, it helped to solve the most important question about the readings and the



contraindications to laminectomy.

At the same time, the collective experience of the Soviet neuropathologists introduced the series/number of supplements, refinements and new data into the symptomatology and the diagnosis of the bullet damages/defeats of spinal cord and their complications.

Thus, in more detail, than in the first world war, are studied the violations of consciousness, and their pathogenesis is illuminated from the positions of I. P. Pavlov's exercise about the higher nervous activity. In particular, was proved the inaccuracy of the assertion of some foreign authors, that the reason for the loss of consciousness during the bullet damages/defeats of spinal cord is the associated jolt of brain.

Is proved also the inaccuracy of previous representations about the fact that with the bullet wounds of spine each case of the loss of the reflector activity of spinal cord during its high damages/defeats is the result only of cerebrospinal shock. Together with shock pathogenesis, the loss of reflexes can be caused by the fact that in the division of spinal cord, arranged/located down from the stricken area, proceed the structural changes as a result of the sharply appearing in it vascular, lymphatic and liquor violations, and also the additional foci, whereas in later periods - developing

changes in the soft cerebral shells.

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It was shown that the reason for cerebrospinal shock is not the surprise stopping of pulse arrival from the brain to the division of spinal cord, arranged/located lower than the focus, as this asserted earlier, but on the contrary, a development in this division of the spinal cord of the condition of Pavlovian beyond the limits inhibition under the effect of the surprise powerful/thick pulse stream on the cerebrospinal guides, the emergent at the moment/torque injuries of these guides.

The established facts, which attest to the fact that the violation of the conductor functions of spinal cord (motor and sensitive, and also active control of the report/event of urination) is conditioned not only on the damage of nerve fibers at the level of the trauma of spinal cord, but also on the onset in them of the parabiologic condition of Vvedenskiy.

The experiment/experience of the Great Patriotic War convincingly showed that at the basis of the stable loss of the conductivity of impulses/momenta/pulses on the spinal cord can lie/rest not only its full/total/complete transverse contamination

with the disagreement of ends (anatomical interruption), but also decomposition of all its nerve fibers (axons) at the region of trauma without the visible macroscopic interruption of brain (axonal interruption).

It is revealed, that in the cases of the axonal interruption of spinal cord (for example, with the full/total/complete cross necroses) after 3-5 weeks after wound its damaged sector can undergo full/total/complete resorption, as a result of which its axonal interruption is converted into the anatomical.

It was shown that in the sharp/acute and early period of the wound of spine the most reliable symptoms of the heavy anatomical damage of spinal cord are solid edema of lower extremities, appearance of the irrepressible developing bedsores into the first 2-4 days after wound and the through either blind characters/natures of the wound of the spinal canal, plotted/applied by bullet or large/coarse fragment.

The experiment/experience of the Great Patriotic War enriched clinic of the bullet damages/defects of spinal cord by the new, for the first time isolated syndromes and clinical forms. From a number of revealed new syndromes deserves attention "perineo-anal root syndrome of position/situation" with the blind-end bullet wounds of

lumbar-sacral division of spinal column, which ensures the correct decision/solution of a question about that, is arranged/located foreign body subdural or epidurally.

On the basis of the experience, obtained in the Great Patriotic War, is for the first time given detailed description of clinic, coursing, conditions of development and treatment of such forms of the complications of the bullet wounds of spine as restricted spinal suppurative meningitis, sharp/acute suppurative external pachymeningitis, abscess of spinal cord. Is in detail studied and is refined the diagnostic and forecasting importance of the investigation of cerebro-spinal fluid/liquid.

In the sharp/acute and early period by the experiment of cerebro-spinal fluid obtained very valuable data for deciding/solving the question about severity and character/nature of the damage of spinal cord. The presence of the drops of myeline and smallest scraps of cerebral tissue with a certainty indicates the extremely heavy damage of brain. The considerable admixture/impurity of the blood in the cerebro-spinal fluid also makes the prognosis worse of the wound of spinal cord, although it does not testify about the anatomical damage of spinal cord, as assumed/set neuropathologists and surgeons in the first world war 1914-1918.

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The investigation of cerebro-spinal fluid provided the timely recognition of suppurative meningitides, in particular, restricted suppurative spinal meningitis, which takes place frequently it is asymptomatic, and in the intermediate and late period - recognition of the compressions of spinal cord with arachnoidal intergrowth and epidural scars.

Are more fully developed the principles of the recognition of character/nature and severity of the damage/defeat of spinal cord, in particular, depending on the periods, which passed from the moment/torque of wound, and also establishment of prognosis with each of them. It is proved that in the majority of the cases of the penetrating wounds of spine the careful analysis of data of both neuro-surgical examination/inspection and X-ray analysis of spine provides the differential diagnosis between the wound of spinal cord and the contusion with its wounding shell through the undamaged/uninjured solid cerebral shell.

By data of the experience, obtained in the Great Patriotic War, is established/installed the rarity of development after the wound of the spine of large hematomas which would squeeze spinal cord. Comparatively rarely were observed tubular hematomyelia.

In an equal manner must be rejected the obsolete position/situation, that with the combined penetrating wounds of spine and intestine intervention on the spinal cord is aimless, since wounded nevertheless perish from the severe suppurative complications with the wounds of spinal cord and its shells. Special intervention in the foremost stages of evacuation on the intestine in combination with the energetic use/application of sulfanilamides in many instances prevented the development of spinal suppurative complications and provided the possibility of successful realization subsequently of operational intervention on the spinal cord or horse tail.

Very essential were achievements in the region of prophylaxis and treatment of suppurative complications in the wounds of spinal cord and its shells. Because of the more advanced organization of medical service and the use/application of sulfanilamides, and in recent years of the war of penicillin, a number of severe suppurative complications in comparison with the first world war was lowered approximately/exemplarily two times. But in the institutions, where especially extensively were used sulfanilamides and was performed the early radical perfecting of wounds, these complications, in particular, meningitides, were observed exclusively rarely.

In the process of studying of this heavy wound and its complications it was possible to come to light/detect/expose the series/number of the laws which made it possible to base the appropriate rational therapeutic measures. A question about the primary necrosis of spinal cord after wound and the complication of its infection is represented in this respect by most important.

The necrosis of the elements/cells of spinal cord as a result of the bullet penetrating wound of spine is basic, determining the boundaries of the damage/defeat of spinal cord. However, the original boundaries of the necrosis of spinal cord can be increased subsequently due to the secondary necrosis, which appears as a result of the series/number of the developing complications (edema, infection, compression, violation of roof and of lymph circulation). The severity of this phenomenon is even more complicated by the fact that the tissue of spinal cord does not regenerate, and the lost functions are not reduced.

The absence of correct representations about the wound process in the spinal cord into the previous wars, the defects of the organizational structure of rendering aid by similar casualty, their scattering according to all hospitals, weak surgical activity in this

case, duration of coursing of this trauma gave full/total/complete basis to doctors, who were not being occupied by specially this question, to count such casualties by completely hopeless ones.

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However, under these conditions already in the first world war appeared the rudiments of the rational tendency to exert such casualties more active aid. It is later, in the war with the White Finns, therapeutic aid by this casualty underwent considerable development, but it was not nevertheless mass. Only in the Great Patriotic War on the basis of Soviet doctors' immense collective experience a question about the treatment of the bullet wounds of spine and spinal cord obtained more or less sufficient illumination.

The primary perfecting of wounds as the measure of struggle with the infection obtained full/total/complete substantiation. Are established/installed the concrete boundaries of primary perfecting for those cases when full/total/complete radical operational aid could not be shown/rendered.

The correct permission of questions of the evacuation of the similar casualties found bright expression in such quantity of produced radical surgery - laminectomy (21.90/o), which was not



produced not into one of the previous wars. Very significant is the fact that the vast majority of these radical interventions is produced in the institutions of army and front line area during the periods up to 10 days, smaller unit - during the period up to one month. It is important to also note that the surgical activity with respect to wounded in the spine progressively was raised with each year of war.

During the study of different complications after the bullet wounds of spine and spinal cord was explained the role of trophoparalytic disorders and infection in the development of the series/number of complications. Became obvious a difference in the concepts "microbial contamination" and the "infection of wound". The latter fact made it possible differently to approach the contaminated wound or the complication and led to the wider imposition of anechoic suture after operation/process even in the cases of unhealed, frequently from suppurative the separable, bullet wound.

The explanation of the pathogenesis of complications from the side of the urinary tracts led to the wide preventive imposition of urinary bladder fistula in the cases of the stable delay of urine. Based on materials of the development of the histories of disease/sickness/illness/malady, urinary bladder fistula was superimposed into 20.20/o of bullet wounds of spine, which were being

escorted/tracked by the delay of urination. Only the timely imposition of urinary bladder fistula should be ascribed a reduction in the frequency of urosepsis as the reasons for death for the time of the Great Patriotic War in comparison with the first world war (N. Burdenko, A. L. Polenov, V. I. Dobrotvorskiy).

Soviet doctors' experience, obtained within the time of the Great Patriotic War, drew nearer us the understanding of the actual reasons for pneumonia, so/such which were being frequently observed in wounded spinal column. The exercise about "paralytic pneumonia", developed by T. S. Istamanovoy, proved to be beneficial for the selection of the rational ways of prophylaxis and treatment of this terrible complication of the wounds of spine and spinal cord.

With each year of war grew on doctors' surgical activity in the treatment of osteomyelitis, in 14.10/o which complicated bullet wounds of spine. In this case came to light the role of the primary radical perfecting of wound in prophylaxis of osteomyelitis.

Thus, the nonpenetrating wounds of spine were triply more frequently complicated by osteomyelitis in comparison with the penetrating wounds, which were more frequently undergoing the early radical surgical perfecting of wound.

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From the second year of war the surgical treatment of osteomyelitis was conducted not only with sharply and subacute, but also with limply flowed/occurred/lasted osteomyelitis, which led to an improvement in the issues of the treatment of this sometimes stable complication.

The active ways of prophylaxis and treatment of different suppurative complications led to a sharp reduction in the complication of the wounds of spine and spinal cord by the sepsis, established/installed only into 5.7o/o with those penetrating and into 1.4o/o with the nonpenetrating wounds. As is known, the majority of casualties (to 80.0o/o) in the war 1914-1918 perished from sepsis and urosepsis.

Prasence in the Great Patriotic War of a considerable number of combined wounds of spine and spinal cord and other cavitary organs/controls and systems required the consumptions/productions/generations of periods, sequence and methods of the operation of such casualties. In this case it was established/installed, that with such wounds in the majority of the cases it is necessary to dismember interventions at two consecutive moments/torques, and under conditions of front line circumstances -

to two "stages" of evacuation.

In this case urgent interventions on the organs/controls of thoracic or abdominal area in the absolute majority of the cases were conducted in the therapeutic institutions of army area (DMP, ~~PPG~~ of the first line), whence after 3-10-15-day hospitalization (depending on coursing of wound process, condition of casualty and sanitary-tactical circumstances) casualties were evacuated into the specialized hospitals of army or front line area for the treatment of the wound of spine and spinal cord. This tactics, as showed experiment/experience, made it possible to preserve by many casualty not only life, but also ability to work, depending on the severity of the damage of the contained spinal canal.

In the Great Patriotic War it is wider than sometimes in other wars, were introduced in the practice of the treatment of those wounded the spine the therapeutic exercise, physiotherapy and sanitation and health treatment. From the first days of war the surgeons greatly extensively used the physiotherapy of both wound itself and complications and consequences of the wound of spine and spinal cord.

Entire presented contributed to an improvement in the issues and to an invariable/unchanged reduction in the lethality with the bullet

wounds of spine and spinal cord with each year of war.

Special attention deserves the use/application of already known ones and the proposition of new orthopedic interventions on the extremities apropos of different consequences of the wound of spinal cord, which have by their target the possible reduction of ability to work.

The practice of wartime it showed that in the treatment of those wounded the spine, together with the neurosurgeon and other specialists, must take active part and the orthopedist. It was necessary to more widely develop the constructions/designs of the orthopedic apparatuses, which facilitate the use of parietic extremities, and to introduce them in the practice of the hospitals, occupied with the treatment of the bullet wounds of spine and spinal cord.

An increase in the residual and return, although y partially, the lost ability to work, because of the use/application of new operational receptions/procedures, medicinal/medicamentous substances and prosthetics, sharply improved in the Great Patriotic War the results of the treatment of those wounded the spine. Although the issues of the wound of spine and spinal cord in the Great Patriotic War are incomparably better than in the previous wars, nevertheless

lethality with them remains thus far even high.

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Were not always correctly put into practice the principles of evacuation on designation/purpose or conducting of the method of the "single" radical perfecting of the wound of spine and spinal cord. However, the deficiencies/lacks indicated to the larger degree depended on circumstances at the front, but not from the principal installations of the doctors in the region of the treatment of the wounds of spine.

The experience, acquired in the Great Patriotic War by neurosurgeons, neuropathologists and other specialists, showed that our knowledge in this region considerably they were spread and were enriched. The continuously continuous development and the study of the consequences of the bullet wounds of spine introduce new lines into the knowledge of the dynamics of the development of the consequences of wound and possibility of their treatment via one either the other structural/design operation/process or by other routes/paths.

One should emphasize that the existed previously opinion that the condition of that wounded into spinal column remains for his

whole life such such as it is composed in the course of the first 3-5 months after wound, it is considerably shaken by the experiment/experience of the Second World War. There are proofs of the fact that the process of reduction of functions is continued also 3 years after wound. Observations show that the repeated or late operations/processes on the spinal cord lead to the considerable improvement in the condition of casualty, which makes it possible to frequently reduce efficiency or self-service one way or another.

Functional results progressively are improved due to produced later many years after the war of reconstructive, reducing and repeated operations/processes. Similar operations/processes find ever increasing use.

The obtained achievements in no case it is not possible to consider limit and, on the contrary, they are the beacon of the future direction of Soviet neurosurgery for achievement of the even greater successes in the matter of the treatment of these heavy casualties, who sacrificed their life and health for the happiness of our Soviet native land.

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